

THE ADULT TRICHOPTERA (INSECTA) OF ALBERTA AND EASTERN BRITISH COLUMBIA, AND THEIR POST-GLACIAL ORIGINS. I. THE FAMILIES RHYACOPHILIDAE AND LIMNEPHILIDAE. SUPPLEMENT 1.

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Six species are described as new: *Rhyacophila simplex*, *R. donaldi*, and *R. autumnalis* of the *Rhyacophilidae*; *Imania thomasi*, *Limnephilus vernalis*, and *Philocasca alba* of the *Limnephilidae*. Previously known species here recognised as members of the study area fauna are: *Rhyacophila vao* Milne, *R. unimaculata* Denning of the *Rhyacophilidae*; and *Dicosmoecus gilvipes* (Hagen), *Neophylax rickeri* Milne, *Limnephilus nimmoi* Roy and Harper, *L. insularis* Schmid, *L. alvatus* Denning, *Lenarchus keratus* Ross, and *Platycentropus plectrus* Ross of the *Limnephilidae*. *Asynarchus lapponicus* (Zetterstedt) (*Limnephilidae*), is more fully described and illustrated. The female of *Rhyacophila milnei* Ross is described and illustrated for the first time; and *Rhyacophila* sp.3, and sp.4 and *Limnephilus* sp.2 are described and illustrated from single females only. Females of *Psychoglypha prita* (Milne) and *P. alascensis* (Banks) are figured and described. *Rhyacophilidae* total 29 species, and *Limnephilidae* 102 species, in the study area. The range type of each species is determined, and the probable post-glacial source for each is considered. The proportions of the fauna of these two families from each source area are now (combining data from this paper, and that to which it is supplementary): from Cordillera south of the ice, 58.7%; from Alaska, 4.5%; from central plains, 6.8%; from eastern North America, 8.4%; from North America as a whole, south of the ice, 19.8%; and indeterminate, 1.5%.

Dans ce travail nous décrivons six nouvelles espèces: *Rhyacophila simplex*, *R. donaldi*, et *R. autumnalis* des *Rhyacophilidae*; *Imania thomasi*, *Limnephilus vernalis*, et *Philocasca alba* des *Limnephilidae*. Nous y ajoutons des espèces déjà décrites mais nouvelles pour notre faune: *Rhyacophila vao* Milne, *R. unimaculata* Denning des *Rhyacophilidae*; *Dicosmoecus gilvipes* (Hagen), *Neophylax rickeri* Milne, *Limnephilus nimmoi* Roy et Harper, *L. insularis* Schmid, *L. alvatus* Denning, *Lenarchus keratus* Ross, et *Platycentropus plectrus* Ross des *Limnephilidae*. Nous illustrons et décrivons plus complètement *Asynarchus lapponicus* (Zetterstedt) (*Limnephilidae*), les femelles de *Rhyacophila milnei*, Ross, *Psychoglypha prita* (Milne), et *P. alascensis* (Banks), et les seules femelles de *Rhyacophila* sp.3 et sp.4 et *Limnephilus* sp.2. Nous reconnaissons présentement pour notre territoire d'étude 29 *Rhyacophilidae* et 102 *Limnephilidae*. Le type de distribution est déterminé et nous discutons l'origine probable depuis les temps glaciaires de chaque espèce. Nous considérons que l'origine de la faune des deux familles dans notre région se partage comme suit (nous combinons les résultats de cette publication et de celles qui lui sont supplémentaires): de la Cordillère au sud des glaciers, 58.7%; de l'Alaska, 4.5%; des plaines centrales, 6.8%; de l'est de l'Amérique du nord, 8.4%; de l'Amérique du nord au sud des glaciers, 19.8%; et demeurant indéterminé, 1.5%.

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Corrigenda to Nimmo, 1971a.

These corrigenda are additional to those listed in Nimmo, 1971b, and 1974.

- p. 18 Couplet 2, choice 'a' - Fig. 65 should read Fig. 64.
- p. 85 Couplet 26, choice 'a' - 'Cercus Triangular . . .' should read 'Clasper triangular . . '.
- p. 111 Line 10. ' . . . segment X distinguished from segment X . . .' should read ' . . . segment IX distinguished from segment X . . '.
- p. 129 Key to *Asynarchus* females, choice '1a', ' . . . enlarge . . .' should read ' . . . enlarged . . '.
- p. 162 Fig. 159. Apparently I made this drawing from a detached aedeagus. The illustration given is presented upside-down and backwards. For proper appearance it should be viewed with the page inverted, with the distal end of aedeagus pointed to the observer's left.

INTRODUCTION

Although the thought was unstated in my 1971(a) paper, it is implicit in a faunal survey that more remains to be discovered. This paper is proof of that. But, apart from finding males for unassociated females, and females for males for which they are yet unknown, neither can this supplement be considered the final word. While I hope to keep supplements to a minimum there will, nevertheless, be further instalments.

The title of this supplement differs from that of my 1971(a) paper, but is equivalent to it, and conforms to that of my series on the Trichoptera fauna, of the study area.

Figure numbering in papers of the main series will be consecutive throughout, except that there will be, if required, a 'Fig. 1' in each paper, followed by a lower case letter. This figure will present collection localities in the study area which are new to the series as a whole. The use of a lower case letter after the '1' follows on in sequence from the suite of locality maps presented in 1971(a). Figure numbering in the supplements to each main paper, on the other hand, will be independent of the main series, but will be consecutive within the supplement series for each main paper. Remarks above on 'Fig. 1' apply equally to the supplements. Fig. 1d serves this paper.

Full collection data are available on file, either from myself, or from the Department of Entomology, University of Alberta, Edmonton. I am adding to these records through continued collecting.

For those species already recorded from the study area, but for which I here record the female, the only literature reference in this paper is to my original record (1971a), giving page and figure numbers.

For species described elsewhere, and recorded here from the study area, I give literature to date, so far as it is known to me.

The genera and species are set out here in the same order as in my 1971(a) paper. Those taxa recorded as new to the area are inserted in the sequence, relative to other taxa, used by Ross (1956) for Rhyacophilidae, and by Schmid (1955) for Limnephilidae.

At the ends of the sections on Rhyacophilidae and Limnephilidae respectively are guides that locate the species, or newly associated sexes in my original (1971a) keys.

In the legend to each plate illustrating genitalia, abbreviations of certain commonly used

words are as follows: 'lateral' to 'lat.'; 'posterior' to 'post.'; 'ventral' to 'ventr.'; 'dorsal' to 'dors.'; 'partial' to 'part.'; and 'segment' to 'Seg.'.

Previous introductory material is in Nimmo (1971a) and Nimmo (1974). Information found therein applies to this paper also.

One problem in the taxonomy of Trichoptera is that, on occasion, females which cannot be associated with known species are encountered. Most authors ignore these, and do not illustrate them. Also, females may be associated with known species, and mentioned in the literature, but not illustrated. Neither practice is sound. An example of the usefulness of illustrating unassociable females is the case of *Limnephilus nimmoi* Roy and Harper, presented in this paper. An example of how failure to illustrate, somewhere, the known female of a known species can lead to confusion is presented by *L. alvatus* Denning in this paper. I illustrate all unassociable females known to me from the study area in the hope that somewhere, someone will recognise the species to which it belongs, and may either publish on the association, or inform me of it.

THE FAMILY RHYACOPHILIDAE STEPHENS

The Genus *Rhyacophila* Pictet

The *vofixa* group

Rhyacophila simplex Nimmo new species

(Fig. 2 a-b, 10-13, 111)

This species is very close to *R. ophrys* Ross. Males may be distinguished from those of *ophrys* by blunter, more angular distal clasper segment (Fig. 10); by simpler segment X with sloped anal sclerite; by apparently non-erectile lateral arms of aedeagus (Fig. 13); and by blunt, recurved horn on postero-dorsal edge of aedeagal sheath.

Description. — Antennae deep red-brown; annular sutures paler. Vertex of head almost black, with lateral sutures and postero-lateral warts paler. Thorax dark brown dorsally, paler to almost white laterally. Spurs brown; formula 3,4,4. Fore-wing length of male 7.2 mm; uniform red-brown except hyaline areas as in Fig. 2a; dorsal surface with patterned distribution of golden hairs, especially on posterior areas. Hind-wing grey-brown, with hyaline areas. Venation as in Fig. 2 a-b.

Male genitalia. (Specimen from Ruby Ck, nr Ruby Lk, at 6750', Waterton National Park, Alberta). Segment IX basically rectangular in lateral aspect, with postero-dorsal edge expanded posterad (Fig. 10); anterior rim partly black-edged. Clasper with parallel sides except antero-ventral portion angled sharply anterad; mesal face with slight meso-dorsal ridge, not quite extended to base; distal segment four-sided, angles rounded, mesal face setose. Segment X ventrad of postero-dorsal edge of segment IX (Fig. 10), with ventral extensions laterally, each flanged posterad by weakly coloured screen; in dorsal aspect segment deeply cleft mesally, bilobed (Fig. 12). Tergal strap inverted-v-shaped anterad of segment X, lightly sclerotised. Anal sclerite tear-shaped in lateral aspect (Fig. 10), partly enclosed by ventral extension of segment X; bifid, flared laterad distally (Fig. 11). Aedeagus short, stout, main body as lightly sclerotised tube (Fig. 13); postero-dorsal extremity projected bluntly dorsad; main shaft very small, with expanded, button-like tip; lateral arms enclosed by main body of aedeagus, roughly triangular in lateral aspect, with thick fringe of setae along distal edge.

Female. Unknown, or unassociated.

Note on habitat. — While I am unfamiliar with the exact location, the single known locality for this species is probably a small, turbulent, stream with rocky bottom.

Holotype. — Male. Ruby Creek, near exit from Ruby Lake, at 6750', Waterton National Park, Alberta (Fig. 111); June 29, 1975; D.B. Donald.

The holotype is in the Canadian National Collection, Ottawa, with type number 15,160.

This species is named with reference to the simplicity of the genital capsule.

The *acropedes* group

Rhyacophila vao Milne, 1936

(Fig. 23-25, 110)

Rhyacophila vao Milne, 1936: 93, 102, 111, Fig. (no number). (Type locality: Cultus Lake, British Columbia). Ross, 1944: 291. Denning, 1948b: 105, plate 2, Fig. 9 - 9b. Ross and Spencer, 1952: 45. Ross, 1956: 117, Fig. 184A-B. Denning, 1956b: 74. Fischer, 1960: 150. Smith, 1965: 243. Smith 1968: 658, 670, 673, Table 1. Schmid, 1970: 87, 132. Fischer,

1971: 132. Anderson and Wold, 1972: Table 1. Newell and Potter, 1973: 14. Schmid, 1974: 933, Fig. 1.

This species is very similar to *R. acropedes* Banks (see Nimmo, 1971a: 23, Fig. 39-41). Males of *R. vao* are distinguished by lack of acuminate process on postero-dorsal edge of segment IX; by presence of lip along disto-ventral area of mesal face of clasper distal segment; and by abrupt constriction of mid-point of basal segment of clasper (Fig. 23). Females are distinguished by carinate postero-ventral edge of segment VIII curved postero-dorsad (Fig. 25).

Description. — Antennae deep yellow-brown, with paler annular sutures. Vertex of head dark brown anteriorly, paler to yellow-brown posteriorly; more uniformly dark brown in female. Thorax brown dorsally, pale straw to almost white laterally. Spurs dark brown. Male fore-wing length 10.08 mm; tinted brown, with faint irroration; with hyaline areas. Hind-wing hyaline basally, faintly tinted grey-brown distally. Female fore-wing warm reddish-brown, with faint distal irroration, plus hyaline areas; hind-wing as in male. Venation indistinguishable from that of *R. acropedes* Banks (see Nimmo, 1971a: Fig. 8a-b).

Male genitalia. (Specimen from Bauerman Bk, nr Twin Lk, 6400', Waterton National Park, Alberta). Segment IX fairly uniformly long in lateral aspect (Fig. 23), with anterior black border broadly indented ventrally; posterior border irregular, with pronounced dorsal process with minute postero-dorsal projection immediately dorsad of segment X base. Clasper with deep base, narrowly constricted posterad then broadly widened distad; distal segment with deep base, abruptly narrowed to roundly tapered disto-ventral portion with heavily setose mesal face; setose portion set off by rounded ventral ridge. Segment X with antero-dorsal bump on each lateral half; each half tapered postero-dorsad; with slight concavity on antero-ventral angle. Aedeagus small, with paired, large, fleshy, ventral lateral arms with lightly sclerotised, semi-circular tips heavily setose (Fig. 24); median shaft sclerotised from base, with even basal 0.66 followed by tapered distal portion curved dorso-posterad.

Female genitalia. (Specimen from Cameron Ck, 5480', Waterton National Park, Alberta). Sclerotised portion of segment VIII evenly tapered posterad, with slight taper at anterior edge (Fig. 25); retractor rod firmly attached at mid-point of lateral edge, with dark, linear, tapered extension ventrad within body of segment wall; postero-ventral surface pinched in mesally, carinate, the keel curved postero-dorsad.

Notes on habitat and activity period. — This species appears to favour the smaller hill streams with gravel or small boulder bottoms, and with medium, at times turbulent, flow. The Alberta flight season extends from about mid-July to late September.

Geographical distribution. — The known range extends from Alaska to Montana and Oregon (Fig. 110), largely confined in Alberta to foothills of the Rocky Mountains, with one record from the south-west flank of the Swan Hills. The known altitudinal range is from 2,500' to 6,400'.

I examined 203 specimens (133 males, and 73 females) from the study area.

Note. — When, in my 1976 summer collecting, many specimens of this species were taken, I checked back to the material recorded in my previous paper (Nimmo, 1971a), for *R. acropedes* Banks. Little material of *R. vao* was found there. That material has been recorded here, and corrections made to the detailed record of *acropedes*. This elision of material from the *acropedes* record does not require changes to my original distribution map (Nimmo, 1971a: Fig. 108).

The *rotunda* group

This group is here recorded for the first time from the study area. The following characterisation is abridged in translation from Schmid (1970:43).

Dorsal processes of segment IX and anal appendages fused throughout their length, projected posterad almost as far as claspers. Segment X a long, curved band; vertical; usually within segment IX. Anal sclerites large, fused on basal half, distinct from apical band. Apical band very large, strongly sclerotised, articulated basally with segment X; free, bifid distally, apparently almost an independent appendage. Aedeagus very large, heavy, deeply concave dorsally; distally bifid with reduced dorsal process. Lateral arms membranous, basally erectile. Claspers short, with distinct relief on mesal face.

Of the six species known from this group, one is here recorded from the study area, and described as new.

Rhyacophila donaldi Nimmo new species

(Fig. 3 a-b, 4 a-b, 14-22, 114)

This species is very similar to *R. ebria* Denning. Males of *R. donaldi* are distinguished from males of *R. ebria* by a variety of minor details. However, the prominent distinguishing feature is the high angular dorsal edge of distal segment of clasper in lateral aspect (Fig. 14). In *R. ebria* this edge is concave ventrad. Females of *R. donaldi* are characterised by dorsal surface of sclerotised portion of segment VIII sharply concave (Fig. 19), and by hyaline 'lobe' immediately posterad of attachment point of retractor rod. Spermathecal sclerite (Fig. 21, 22) membranous dorsally, with complexly folded ventral plate with pair of ventro-lateral apertures.

Description. — Antennae very dark brown, except inter-annular sutures paler. Vertex of head very dark brown, almost black, with warts very slightly paler. Thorax very dark brown, with pleura slightly paler. Spurs brown; formula 3,4,4. Fore-wing length of male 7.84 mm; uniform red-brown, veins darker, with hyaline areas as in Fig. 3a. Venation of male as in Fig. 3 a-b; of female as in Fig. 4 a-b.

Male genitalia. (Specimen from Rowe Bk, 6550', Waterton National Park, Alberta). Segment IX with long dorsal area; narrowed rather abruptly ventrad to form short ventral area (Fig. 14); dorsal area, in dorsal aspect, with deep cleft in posterior edge to receive dorsal process of segment IX (Fig. 15); this process rounded, curved slightly postero-ventrad, situated immediately dorsad of, and apparently fused to dorsal lobe of segment X. Clasper directed postero-dorsad, with ridged and folded mesal face (Fig. 14), with tuft of long, black setae on disto-dorsal angle; distal segment angular except rounded postero-ventrad directed extremity with mesal face setose. Segment X, other than dorsal process, of two long, narrow straps dependent from antero-ventral corners of process to engage antero-lateral edges of distal portion of tergal strap (Fig. 16). Distal portion of tergal strap deeply cleft, each half with edges folded dorsad to enclose ventro-lateral lobes of anal sclerite (Fig. 17). Aedeagus with lateral arms dependent from baso-ventral portion; basal two-thirds of arms membranous, erectile (Fig. 18); distal third weakly coloured, sclerotised, curved dorsad; spinate along edges and mesal face; median shaft scoop-like, with upturned lateral edges; with heavily sclerotised distal portion curved, tooth-like; ejaculatory duct terminated at tip of recurved, tapered, dorsally directed process.

Female genitalia. (Specimen from Bertha Bk, 6000', Waterton National Park). Segment VIII with sclerotised portion tapered, mid-portion of dorsal surface sharply concave (Fig. 19); postero-dorsal edge indistinctly merged with membranous area; retractor rod fused to anterior edge, adjacent to short, rounded hyaline area (Fig. 19). Spermathecal sclerite complex, with membranous dorsal area, very distinct, folded ventral sclerite with lateral apertures at mid-point of length (Fig. 21, 22); sclerite deeply cleft along ventral mid-line from anterior edge; small angular sclerite located antero-dorsad of ventral sclerite, one on each side.

Notes on habitat and activity period. — I am not directly familiar with the localities recorded for this species, but they appear to be in the sub-alpine area of Waterton National Park, and are very likely small, shallow streams flowing over gravel, sand, or small rock bottoms, with occasional rapids or small falls. Flight season is known to extend at least over the period August 10 to September 8.

Holotype. — Male. Rowe Bk, 6,550', Waterton National Park, Alberta (Fig. 114); August 10, 1975; D.B. Donald.

Allotype. — Female. Bertha Bk, 6,000', Waterton National Park, Alberta; August 30, 1975; D.B. Donald.

Paratypes. — Bertha Bk, 6,000', Waterton National Park, Alberta; August 30, 1975; D.B. Donald; six males, two females. Lineham Bk, 7,050', Waterton National Park, Alberta; September 7, 1975; D.B. Donald; two males, one female. Bertha Bk, 6,000', Waterton National Park, Alberta; August 25, 1976; D.B. Donald; nine males, three females.

The holotype, allotype, and Bertha Bk (30/8/75) paratypes are in the Canadian National Collection, Ottawa, with type series number 15,161. The Bertha Bk (25/8/76) paratypes are in collections of the following institutions: four males, one female to Department of Entomology, University of Alberta; five males, two females to Royal Ontario Museum, Toronto. The Lineham Bk paratypes are in United States National Museum, Washington D.C., U.S.A.

This species is named for David B. Donald, Canadian Wildlife Service, University of Calgary, collector of the type series.

The *sibirica* group
Rhyacophila unimaculata Denning, 1941
 (Fig. 30-31, 111)

Rhyacophila unimaculata Denning, 1941: 198 - 199, Fig. 7. (Type locality: Robson, British Columbia). Ross, 1944: 291. Ross and Spencer, 1952: 45. Ross, 1956: 120, Fig. 234A, G. Ross, 1965: 591. Schmid, 1970: 65, 126, Plate 15, Fig. 4 - 8. Fischer, 1971: 130. Newell and Potter, 1973: 13.

In the study area this species is quite distinctive. The most prominent features are: long, distally flared dorsal lobe of segment X; and long, horizontal, stout ventral lobe, in lateral aspect (Fig. 30).

Description. — (Taken from pinned specimen). Antennae deep red-brown. Vertex of head dark chocolate-brown, almost black, warts slightly paler. Thorax overall virtually black. Legs red-brown to straw-colored, somewhat banded middle legs; spurs formula 3,4,4. Fore-wing length of male 10.24 mm; translucent deep grey-brown, faintly irrorate, with larger hyaline areas at distal ends of marginal cells f1, f3, f4, f5, and between M3+4 and wing edge basad of termination of A. Hindwings translucent grey-brown disto-anterad, remainder hyaline. Stigma evident, not prominent, on both wings. Venation little different from that of *R. rickerti* Ross (Nimmo, 1971a: Fig. 12 a - b) except fore-wing cross-vein r1 - r2 present; no drawing is available as only holotype examined, which is pinned, with wings attached and rumpled somewhat.

Male genitalia. (Specimen from Robson, British Columbia. Holotype). Segment IX massive, longer dorsally, constricted toward ventral area (Fig. 30), antero-ventral edge paler. Clasper with irregular, slightly tapered proximal segment with concave mesal face; distal segment tapered distad, curled disto-mesad, with concave disto-mesal face; disto-mesal surface clothed in fine, very short pilosity. Segment X large, in lateral aspect like V on side; dorsal lobe projected postero-dorsad, with complexly folded anterior portion, and distal doubly cleft tip (Fig. 31), with paired, flared lateral flaps setose on mesal face; ventral lobe massive, horizontal, distally slightly cleft mesally, black distally, with dorsal groove. Aedeagus massive, complex (Fig. 32); dorsal lobe with concave dorsal surface, tip curved dorsad with shallow mesal cleft; ventral lobe originated from large, bulbous, membranous mass, long, sclerotised, wide with disto-dorsal surface concave, all with dorsal surface with minute, posteriorly directed, triangular dentitions, fewer distally; median shaft sclerotised, with paired lateral flanges with free distal spines, basal two-thirds arched dorso-laterad then ventrad; ejaculatory duct on long, thin tube, sinuate, directed postero-dorsad, with slight distal flare. Sclerotised tubular base of aedeagus with dorsal process from antero-dorsal edge, which abuts on antero-ventral edge of ventral lobe of segment X.

Female. Unknown, or not yet associated.

Notes on habitat. — None of the three recorded localities is directly known to me; I have not been to western Montana, and the Fernie and Robson, British Columbia localities are insufficiently precise, being, presumably, the nearest named places. However, all three localities are at relatively low altitudes, in areas along the eastern periphery of the Rocky Mountain Trench, and higher than the floor of the trench except perhaps in western Montana. The only collecting date known to me, April 16, at Robson, B.C., probably explains why this species is so rarely taken, as it is well in advance of the great majority of other Trichoptera species in the area, and therefore of the usual field season.

Geographical distribution. — This species is presently known only from localities at low altitude, along the southern half of the Rocky Mountain Trench. Altitudes known to me are (approximately) 3,000' and 3,300'. See Fig. 111.

The *verrula* group
Rhyacophila autumnalis Nimmo new species
 (Fig. 5 a-b, 26-29, 112)

This species is similar to *R. potteri* Denning and Schmid (1971: 1556). Male *R. autumnalis* are distinguished by distal clasper segment strongly tapered to fairly fine tip (Fig. 26), basal segment of fairly uniform height; dorsal lobe of segment X complexly folded in lateral aspect, smoothly curved postero-dorsal lobe of segment IX with dorsal, ventral sides, and tip concave and dorsal concavity extended anterad as deep trough to dorsal surface of main body segment.

Description. — Antennae uniform dull-brown. Vertex of head chocolate-brown except warts, lateral sutures, and postero-mesal area deep yellow-brown. Thorax deep brown to pale dorsally, generally pale yellow-brown laterally. Fore-leg spurs straw-yellow; remainder dark brown; formula 3,4,4. Fore-wing length of male 9.44 mm; pale grey-brown; heavily

irrorate, with solid colouration less than 50% of wing area. Hind-wing hyaline generally, with dusky grey areas at terminations of veins R2 to Cu1b. Venation of male as in Fig. 5 a-b.

Male genitalia. (Specimen from Rowe Bk, 6350', Waterton National Park, Alberta). Segment IX massive (Fig. 26), with long dorsal strap and ventral surface, longer lateral walls; notable is process of postero-dorsal edge, directed postero-dorsad, with concave dorsal and ventral surfaces, and tip; black border to anterior edges of segment. Clasper with large, irregular, parallel-sided basal segment with proximal and distal areas of mesal face membranous; distal segment triangular, strongly tapered to tip. Segment X large, projected posterad of segment IX dorsal process; complexly folded dorsal surface, broadly cleft postero-mesally (Fig. 28); with paired lateral straps dependent from antero-lateral corners. Anal sclerite large, sinuately curved ventro-anterad then ventrad to lower portion of segment IX and clasper base area (Fig. 26); concave on posterior face to enclose similarly sinuate, darker, tergal strap (Fig. 26, 27). Aedeagus with membranous base and clear, sclerotised lobe dorsad of median shaft base (Fig. 29); base of median shaft a membranous lobe with sclerotised dorso-anterad hook; distad of hook a thin, membranous tube followed by thin, irregular, sclerotised tube; lateral arms with common, long, membranous base originated ventrad of other structures; separate sclerotised distal arms broadly blade-like, tapered to blunt tip, with dorsal portion of median face heavily setose.

Female. Unknown, or unassociated.

Notes on habitat and activity period. — This species appears to favour small gravel or rocky creeks close to or in the sub-alpine region. Flight date records extend from August 24 to September 12.

Holotype. — Male. Rowe Bk, 6,350', Waterton National Park, Alberta; September 12, 1975; D.B. Donald. (Fig. 112).

Paratypes. — Same data as holotype; four males. Ruby Bk, 6,750', Waterton National Park, Alberta; 24/8/75; D.B. Donald; one male.

The holotype and two of the Rowe Bk paratypes are in the Canadian National Collection, Ottawa, with type series number 15,162. The Ruby Ck paratype is in the Department of Entomology, University of Alberta, and one each of the remaining Rowe Bk paratypes is in the Royal Ontario Museum, Toronto, and the United States National Museum, Washington, D.C., U.S.A.

This species is named with reference to the autumnal flight period.

The vagrita group
Rhyacophila milnei Ross, 1950
(Fig. 33-34, 112)

Rhyacophila milnei; Nimmo, 1971a: 36 - 37, Fig. 93 - 95, 119.

Description. — The females are like males, except that the female antennae are very dark brown, almost black. Also, while the middle and hind-leg spurs are longer than those of the fore-leg, and stout, they are not remarkably long.

Female genitalia. (Specimen from Twin Ck, Marmot Basin, west of Kananaskis River). Sclerotised portion of segment VIII evenly tapered posterad (Fig. 33), concave dorsally for most of length; retractor rod firmly, broadly attached to anterior edge, with less darkly sclerotised, rounded area extended along segment side to enclose elliptical, hyaline spot. Spermathecal sclerite minute, sinuate in lateral aspect, ends acuminate; in ventral aspect (Fig. 34) sclerite bifid, cleft from posterior end; lobes arcuate, tapered, acuminate posteriorly; sclerite with small, rounded process anterad.

Notes on habitat and activity period. — I have not visited the collection site, which is a sub-alpine, or close to sub-alpine area in which Twin Ck may be expected to be small, bubbling, with gravel to small boulder bottom. Combining capture date information with that given for the male paratype in my 1971(a) paper, the flight period for this species is increased to at least one month, from September 5 to October 5.

Geographical distribution. — The locality recorded here is about 25 miles southeast of the type locality (Fig. 112), at about 6,500'.

I examined three specimens of this species, two males, one female, all from the same locality and date. These were obtained by R. Mutch of the University of Calgary.

Unassociated females

I record here two further species of *Rhyacophila* from the study area, each represented by

single females. They do not approximate in characters to any species of which I have knowledge. These two species are numbered onward consecutively from the two species recorded in my 1971(a) paper, represented only by females.

Rhyacophila species 3
(Fig. 6 a-b, 35-37, 113)

This female is distinguished by retractor rod unattached to anterior edge of segment VIII, which is produced anterad as small stubby process to meet rod (Fig. 35). Anterior border of segment VIII tapered shortly anterad.

Description. — Antennae chocolate-brown, inter-annular sutures paler. Vertex of head deep chocolate-brown with lateral sutures almost white; warts slightly paler. Thorax deep chocolate-brown dorsally, with mixed darker and paler areas laterally. Spurs deep yellowish brown; formula 3,4,4. Fore-wing length of female 14.92 mm; brown, generally irrorate. Venation of female as in Fig. 6 a-b.

Male. Unknown, or not yet associated.

Female genitalia. (Specimen from Bertha Bk, 6000', Waterton National Park, Alberta). Sclerotised portion of segment VIII tapered posterad in lateral aspect (Fig. 35) with ventral surface curved gently postero-dorsad; anterior end tapered slightly anterad, with sharp ridge demarcating anterior and posterior tapers. Retractor rod 'socketed' into small process of antero-lateral edge, posterad of which is a small oval hyaline area. Spermathecal sclerite complex (Fig. 36, 37); of two main lateral parts, darker interior sclerite centrally, and smaller posteriorly-hooked anterior sclerite partly internal; main body of spermathecal sclerite long, tapered, acuminate in lateral aspect, tapered, blunt, rounded in dorsal aspect. Antero-ventral angles of each half of main sclerite produced antero-ventrad as broad flaps which enclose yet another anterior sclerite attached to membranous anterior tube; in dorsal aspect this sclerite is compositely triangular.

Notes on habitat and activity period. — The single locality for this species is a small stream with pebble bottom, with scattered larger rocks, overhung by willows. Date of capture was June 25.

Geographical distribution. — Only one locality is known for this species, in extreme southwestern Alberta, in the mountains (Fig. 113). Elevation 6,000'.

Rhyacophila species 4
(Fig. 7 a-b, 38-41, 113)

This female is distinguished by retractor rod firmly attached to anterior edge of segment VIII (Fig. 38), with three tapered, black, acuminate lines produced at right angles to each other from point of attachment. Spermathecal sclerite single, wedge-shaped in lateral aspect (Fig. 41).

Description. — Antennae, head, and thorax black. Spurs dull grey-brown; formula 3,4,4. Fore-wing length of female 8.32 mm; dark grey-brown with paler patches in distal cells, costal area, and termination of cubital and anal veins. Venation of female as in Fig. 7 a-b.

Male. Unknown, or not yet associated.

Female genitalia. (Specimen from small stream on north side Scalp Ck road, north boundary of Ya Ha Tinda Ranch, Alberta). Sclerotised portion of segment VIII tapered postero-dorsad (Fig. 38); with dorso-lateral lobe at posterior edge; postero-ventral edge acuminate in lateral aspect, shallowly cleft mesally in ventral aspect (Fig. 39); retractor rod firmly attached to lateral edge, with three black, acuminate 'arms' radiated at right angles from point of attachment; median 'arm' terminated adjacent to elliptical hyaline spot. Spermathecal sclerite in lateral aspect wedge-shaped (Fig. 41), very dark about edges, with acuminate posterior end; merged anterad to rectangular anterior portion from ventral surface of which depends a lightly sclerotised, irregular tube; in ventral aspect (Fig. 40) sclerite with curved lateral edges, tapered to rounded posterior end; anterior end semi-circular.

Notes on habitat and activity period. — This specimen was taken adjacent to a very small (maximum width about 12"), cold stream flowing in pools and riffles, often under moss floor of an aspen forest. Date of capture was July 16.

Geographical distribution. — The Ya Ha Tinda Ranch is located in hill country on north side of the Red Deer River, between first and second ranges of the eastern Rocky Mountains (Fig. 113). Elevation of collection point about 5,800'.

Notes on species of *Rhyacophila*
previously recorded from Study Area (Nimmo, 1971a)

These notes are derived from Schmid's (1970) revision of the genus *Rhyacophila*.

Rhyacophila narvae Navás, 1926

Rhyacophila vepulsa Milne. Nimmo, 1971a: 28-29.

Rhyacophila narvae Navás, 1926: 57, Pl. 1 Fig. 7. (Type locality: Vladivostok). Schmid, 1970: 125; (*vepulsa* as junior synonym of *narvae*). (See Fischer, 1960: 107, and 1971: 103 for palaearctic literature).

The range of this species includes eastern Siberia and western Canada.

Rhyacophila vobara Milne, 1936

Rhyacophila vobara Milne. Nimmo, 1971a: 32-33.

Schmid (1970) places this species in the *vofixa* group, removing it from its own nominal group.

Rhyacophila bifila Banks, 1914

Rhyacophila bifila Banks. Nimmo, 1971a: 25.

Schmid (1970) removes this species from the *invaria* group and places it in the *coloradensis* group.

Rhyacophila coloradensis Banks, 1904

Rhyacophila coloradensis Banks. Nimmo, 1971a: 26.

Schmid (1970) removes this species from the *invaria* group and places it in the *coloradensis* group.

Rhyacophila vocala Milne, 1936

Rhyacophila hyalinata Banks. Nimmo, 1971a: 17, 18, 27, 203, 205, 214, Fig. 11 a-b, 51 - 53, 111.

D.G. Denning (pers. comm.) pointed out that my identification of this species is incorrect. As a result, the bibliography presented under *R. hyalinata* Banks, 1905, on p. 27 (Nimmo, 1971a) is to be deleted. Following is the correct bibliography for *R. vocala* Milne, 1936:

Rhyacophila vocala Milne, 1936: 100, 102, Fig. (unnumbered). (Type locality: Cultus Lake, British Columbia). Ross, 1944: 291. Denning, 1948b: 106, Pl. 4 Fig. 16 - 16B. Ross and Spencer, 1952: 45. Ross, 1956: 118. Denning, 1956a: 235, Fig. 10, 11e. Fischer, 1960: 152. Smith, 1968: 658, 663, 672, 673, Tab. 1. Schmid, 1970: 59, 124, Pl. 15 Fig. 1 - 3, Pl. 50 Fig. 4 - 5. Fischer, 1971: 135. Newell and Potter, 1973: 14.

Deleting the distribution for *hyalinata* from Fig. 111 (Nimmo, 1971a), the distribution of *vocala* extends from Alberta and southern British Columbia to California.

Placement of Species of *Rhyacophila*
new to Study Area, in Keys previously constructed

Males. Refer to key on p. 16 of Nimmo, 1971a.

R. simplex Nimmo n. sp. keys to 18a, wherein it may be distinguished by simple lateral lobe of segment X, horizontal in lateral aspect (Fig. 10).

R. vao Milne keys to 14b wherein it may be distinguished by anal sclerite absent (Fig. 23).

R. donaldi Nimmo n. sp. keys to 7a wherein it may be distinguished by postero-dorsal lobe of segment IX fused dorsally to segment X (Fig. 14).

R. unimaculata Denning keys to 16a wherein it may be distinguished by segment X V-shaped in lateral aspect (Fig. 39), with dorsal lobe narrow, flared distally.

R. autumnalis Nimmo n. sp. keys to 10a, wherein it may be distinguished by tergal strap not dish-like; segment X of one, horizontal, convolute sclerite (Fig. 26).

Females. Refer to key on p. 18 of Nimmo, 1971a.

R. vao Milne keys to 11a wherein it may be distinguished by keel curved, postero-dorsad (Fig. 25).

R. donaldi Nimmo n. sp. keys to 8, wherein it may be distinguished by short spermathecal sclerite complexly folded within itself, with paired ventro-lateral apertures (Fig. 21).

R. milnei Ross keys to 14 wherein it may be distinguished by spermathecal sclerite deeply bifid posteriorly, in ventral aspect (Fig. 34).

R. species 3 keys to 14 wherein it may be distinguished by spermathecal sclerite composed of complex of four sclerites intricately folded within each other (Fig. 36).

R. species 4 keys to 9a wherein it may be distinguished by postero-lateral edge of segment VIII with posterior edge sinuate in lateral aspect (Fig. 38).

Finally, couplet 10 should be reworded as follows:

- 10a. (9a) Anterior border of sclerotised segment VIII without hyaline spot laterally (Fig. 100 (Nimmo, 1971a)) *R. species 1*
- 10b. Anterior border of sclerotised segment VIII with hyaline spot laterally (omitted in Fig. 61 of Nimmo, 1971a). . . *R. narvae* Navás (= *repulsa* Milne)

THE FAMILY LIMNEPHILIDAE KOLENATI

The Subfamily Dicosmoecinae Schmid

The Genus *Dicosmoecus* McLachlan

Dicosmoecus gilvipes (Hagen), 1875

(Fig. 42-46, 114)

Stenophylax gilvipes Hagen, 1875: 601-602, 605. (Type locality: Colorado). Putnam, 1876: 205.

Dicosmoecus gilvipes; McLachlan, 1875: 113. Banks, 1892: 364. Ulmer, 1905: 20. Ulmer, 1907: 60. Banks, 1907: 38.

Dodds and Hisaw, 1925a: 125, Fig. 6. Dodds and Hisaw, 1925b: 386. Essig, 1926: 176. Neave, 1929: 189. Betten *et al*, 1934: 53, 318, Textfig. 271, m, q. Milne, 1935: 36, 50. Ross, 1938b: 30. Balduf, 1939: 122, Fig. 62b. Banks, 1943: 360, Pl. 4 Fig. 89, Pl. 5 Fig. 99, 107, 110, 111. Ross, 1944: 297. Schmid and Guppy, 1952: 42. Ross and Spencer, 1952: 47. Schmid, 1955: 36, Fig. 3e, 9-10. Flint, 1960: 23-24, Fig. 4. Flint, 1966: 367, Fig. 2 i, h. Anderson, 1967: Table II. Fischer, 1967: 65-66. Fischer, 1973: 12-13.

This is the third species of *Dicosmoecus* recorded from the study area. Males are distinguished by presence of small, slightly clavate lobe originated just ventrad of clasper base (Fig. 42); by notch in dorsal edge of distal clasper segment, at base; and by several other minor characters. However, the best character is the form of the mesal ridge of the basal clasper segment viewed from posterior (Fig. 43); with straight, rounded ventral ridge at 45°

to vertical, dorso-laterad of which is a distinct, thin-walled, black tooth directed postero-laterad.

Females are distinguished by apparent absence of supragenital plate (Fig. 46); by massive vulval scale fused dorso-mesally; by inverted-triangular median lobe of vulval scale; by short, triangular segment X (Fig. 45); and by sharply triangular ventro-lateral lobes of segment IX.

Description. — Antennae very dark grey, annuli anterior faces pale; scape antero-mesal face cream-colored, glabrous. Vertex of head black, faded posterad to red-brown. Frons clothed in golden hair; warts of vertex with black or white hairs; hairs of antennal scape golden. Thorax very dark brown, faded to red-brown and yellow, dorsally; laterally straw-colored to red-brown, with some very dark brown areas. Thoracic hairs very fine, white except at fore-wing base heavier (setose), black. Legs yellow except hind-legs darker straw-colored. Spurs red-brown; formula 1,3,4. Fore-wing length of male 24.8 mm; deep grey-brown, semi-translucent, with veins deep brown, almost black; hyaline areas basad of divergence of M1+2 and M3, at termination of Cu2 and anal veins, and adjacent to termination of C. Hind-wing uniform pale grey. Venation as for *Dicosmoecus jucundus* Banks (Nimmo, 1971a: Fig. 122 a-b).

Male genitalia. (Specimen from Oldman R., Hwy 922, nr Maycroft, Alberta). Segment VIII tergum with paler posterior border. Segment IX high, irregularly slender (Fig. 42); with projection posterad of postero-ventral edge in lateral aspect; with basal portion of antero-lateral edge black, the black line curved postero-dorsad parallel to clasper base. Clasper with massive, slightly tapered proximal segment in lateral aspect; distal segment with broad base narrower than distal edge of proximal segment, distinct notch at baso-dorsal angle, distal process long, tapered, distally acuminate, curved postero-mesad. Mesal face of proximal segment of clasper concave, with baso-mesal edge with oblique ridge slanted latero-ventrad (Fig. 43); ridge with dorso-lateral, black, sharp-edged tooth ventro-mesad of which is a long, rounded ridge. Dorsal strap of segment IX high, narrow, indistinguishable from segment X. Cerci long, parallel-sided in lateral aspect, concave on mesal face, with fringe of setae distally. Median lobes of segment X dorsad of anus bifid, short, rounded, closely appressed; ventro-lateral lobes long, slender, slightly clavate distally, each with short, thumblike subsidiary lobe slightly dorso-mesad of base; ventro-lateral lobe pair connected with median bridge arched dorsad just below anus; posterior edge of bridge projected postero-dorsad, parallel-sided, rounded distally, dark. Postero-ventral angle of segment X projected postero-ventrad as large ledge which bears above assemblage of lobes. Aedeagus long, slender, parallel-sided, with rounded distal head slightly delimited; lateral arms originated basad of head, on ventro-lateral face; not quite extended to tip of median shaft, tapered, acuminate, with fringe of short, heavy, black spines on dorsal edge, a few such spines scattered on ventral edge (Fig. 44).

Female genitalia. (Specimen from Clatsop County, Oregon). Posterior edge sternum VII widely bordered with fine hairs. Vulval scale massive, with lateral lobes fused dorso-mesally (Fig. 46), with meso-ventral faces deeply recessed; median lobe with narrow base, triangularly expanded distally, disto-lateral angles housed in lateral lobe recesses. Segment IX in lateral aspect with irregular dorsal portion ventrally concave; dependent from antero-lateral angles a triangular sclerotised lateral process with narrow bridge to main segment body (Fig. 45), laterad of vulval scale, embedded in membrane. Segment X small, triangular, demarcated from IX by curved, abrupt declivity; mesally cleft in ventral aspect (Fig. 46); with mesally directed, narrow, rounded lobes from antero-lateral angles. No evident supragenital plate.

Notes on habitat and activity period. — The single specimen taken by myself was under a bridge high above the Oldman River at a point where it emerges from the mountains, through Foothills region. There, the river is roughly 150' wide, forming shallow rapids over large rocks fragmented from cliffs on either side. Neave (1929) records the species from two lakes in Jasper National Park, but I suspect these were adults that flew in from surrounding streams which, in that area, are the smaller, mountain type. Known dates of capture are July 24, August 27, and September 5.

Geographical distribution. — This species is known from British Columbia south to California and Colorado (Fig. 114), with three records from Alberta. Known altitudes are 4,000', 4,900', and 5,490'.

I have examined two specimens, one male, one female.

The Genus *Imania* Martynov

The *tripunctata* group

Imania thomasi Nimmo new species

(Fig. 8 a-b, 56-58, 115)

Males of this species, compared to others of *tripunctata* group, are distinguished by clasper distal segment trilobed, dorso-lateral lobe deeply cleft longitudinally as dorsal, ventral lobes (Fig. 56, 57); segment X distal edge triangularly cleft (Fig. 57); aedeagus basal portion with

four, paired, lobes (Fig. 58), aedeagus distal portion elongated, tip concave dorsally, edges flared dorso-laterad.

Description. — Antennae brownish black. Vertex of head black. Thorax black dorsally, with slightly paler areas laterad. Spurs brown; formula 1,3,3. Fore-wing length of male 8 mm; translucent purplish brown; with hyaline areas as in Fig. 8a. Venation of males as in Fig. 8 a-b.

Male genitalia. (Specimen from Rowe Bk, 6350', Waterton National Park, Alberta). Segment IX of uniform width, except ventral surface expanded posterad; curved gently dorso-posterad; with black bordered anterior edge (Fig. 56). Clasper massive, with large, roughly elliptical in lateral aspect, basal segment; antero-mesal angle developed meso-posterad as long, sinuate, slender, acuminate process (Fig. 57). Distal clasper segment trifid; in lateral aspect lateral face expanded broadly distad; deeply, broadly cleft to dorsal and ventral lobes; mesal lobe developed from meso-basal area of segment, thin-walled dorso-ventrally (Fig. 57), finger-like in lateral aspect (Fig. 56); all three lobes toothed as in Fig. 57. Segment X uncertain in nature; possibly ventral portion fused to long, slender, down-curved process developed from postero-dorsal edge of segment IX (Fig. 56); ventral portion v-cleft distally (Fig. 57), with bridge between lateral halves, and aperture anterad of bridge. Aedeagus (Fig. 58) very long, with sclerotised, tubular base; middle portion with two pairs of dorsal arms; proximal pair relatively straight, black, originated dorsally; distal pair lightly sclerotised, distally curved postero-ventrad to acuminate tip, thin blades. Distal portion of aedeagus dependent postero-ventrad below base of distal arms, long, bulbed two-thirds distance from tip; bulb with aperture of ejaculatory duct; distad of bulb a constriction, flared to dorsally concave, thin-walled tip.

Female. Unknown, or not yet associated.

Notes on habitat. — The two localities for this species are both at, or above, the sub-alpine region. The streams adjacent to which specimens were taken are both small, relatively shallow, with gravelled or small boulder bottoms, with occasional rapids or small falls.

Geographical distribution. — The localities are in mountainous country, close to the alpine region, and about 200 miles apart, north to south (Fig. 115), in Alberta only. Altitudinal range is from 6,350' to 6,500'.

I examined three males of this species.

Holotype. — Male. Rowe Bk, 6,350', Waterton National Park, Alberta; 12/6/75; D.B. Donald.

Paratypes. — Twin Ck, Marmot Basin, west of Kananaskis R., Alberta; 12/5/75; R. Mutch; one male. Twin Ck (as above); 26/6/76; R. Mutch; one male.

The second paratype has wings fragmented, from time of collection.

The holotype and Twin Ck (26/6/76) paratype are in the Canadian National Collection, Ottawa, with type series number 15,163. The Twin Ck (12/5/75) paratype is in the Department of Entomology, University of Alberta.

This species is named for my late father-in-law, Thomas Finlay Hird, M.D.

The Subfamily Neophylacinae Schmid The Genus *Neophylax* McLachlan

This genus is recorded for the first time from the study area, where it is represented by one species. The following characterisation is abridged in translation from Schmid (1955: 93-96).

Synopsis of characters. — Medium to small, slender, with wings strongly irrorate, hairy.

Male maxillary palps very large, first article short, second at least as long as scape. Meso-apical spur of male hind-leg modified. Specimens of most species with process directed posterad from sternum VI and/or VII. Posterior borders of abdominal segments of both sexes often with fine granular pattern. Wing from various species with smaller members with anterior wings distally angular; in species with larger members, anterior wings elongated. Venation much as in Fig. 9 a-b (this paper), with variations between species, and minor sexual dimorphism. Male genitalia with segment IX massive, with postero-ventral process; dorsal process often very long, tapered, fused at least basally. Median lobes of segment X primitively small, weakly concave; large, curved in advanced species; never fused to segment IX. Aedeagus small, located dorsally, between dorsal processes of segment IX; lateral arms absent. Claspers not projected; basal article much reduced, composed of irregular field ventrad of aedeagus; apical article often bifid, complex, with points or dentitions. Female genitalia scarcely distinguished from *Oligophlebo-*des except on basis of vulval scale which is primitively very small, lightly sclerotised, flanked

laterad by ventral lobes of segment IX fused to it. In more advanced species vulval scale more strongly sclerotised, generally bifid; segment IX ventral lobes almost completely fused laterally.

The *rickeri* group

Neophylax rickeri Milne, 1935

(Fig. 9 a-b, 47-55, 115)

Neophylax rickeri Milne, 1935: 22, 52. (Type locality: Cultus Lk, British Columbia). Ross, 1944: 300. Denning, 1948a: 122, Pl. 7 Fig. 7-7A. Schmid and Guppy, 1952: 42. Ross and Spencer, 1952: 50. Schmid, 1955: 97, Fig. 58-59, 61c, 62c. Denning, 1956a: 262, Fig. 10.29i. Fischer, 1967: 141-142. Anderson and Wold, 1972: 197, 198, 199, 200. Fischer, 1973: 37.

Neophylax pulchellus Ling, 1938: 68-69. (Type locality: Oakland, California). Ross, 1944: 300. Fischer, 1967: 142.

Males of this species may be distinguished by postero-dorsal lobes of segment IX extended well posterad of remainder of genitalia (Fig. 47); and by form of postero-median plaque (Fig. 50) in posterior aspect.

Description. — Antennae straw-coloured; scape, pedicel, dark brown; up to ninth annulus with dark brown band around posterior half of distal edge, near inter-annular suture. Vertex of head yellow-brown, with areas bounded by lateral ocellus, frontal wart, and median wart grey-brown; warts grey-brown. Thorax with ground of straw colour, shaded to grey-brown in parts. Spurs red-brown; formula 1,3,3; disto-mesal spur of male hind leg modified as in Fig. 55; distal edge of spur sheath apparently fibrous. Male fore-wing 13.92 mm; dark grey, with scattered irrorations, especially in costal area; pattern augmented by areas of silver and gold hairs; postero-distal edge markedly sinuate, with unusually distinct angle on posterior edge of termination of Cu2 and anal veins. Hind-wing translucent grey. Venation of male as in Fig. 9 a-b.

Male genitalia. (Specimen from Galwey Bk, Highway 6, just north of Waterton National Park boundary, Alberta). Sternum VII with posterior projection, broad, rounded process (Fig. 52); posterior area of sternum with minute ovoid markings anterad of which is a narrower band of linear markings. Posterior area of sternum VIII with similar linear markings. Segment IX with area of linear markings (not illustrated). Segment IX large, bulky, with anterior edge folded somewhat upon itself (Fig. 47); with postero-ventral area angled dorsad at about 45°, biconcave, each concavity with tuft of long setae directed postero-dorsad (Fig. 47, 49); separated by median keel; dorsad of concavities a broadly based, tapered, black process with irregular, transverse ridges with edges directed distad. Dorsal strap of segment IX laterally narrow; dorsally expanded postero-ventrad in median line as bifid, tapered process, more widely separated proximally than distally (Fig. 47, 48, 50). Claspers short in lateral aspect; exposed part inverted triangular; irregularly rounded in posterior aspect, with latero-dorsal ridge, median black-bordered declivity within which disto-lateral flanges of segment X are housed. Segment X massive, of two parts, one either side of segment IX dorsal strap processes; with very large, conical dorsal part hollow anteriorly, tapered to distinct, black tip with flanges developed latero-antegrad; lobes of segment directed postero-ventrad. Aedeagus minute, housed between lobes of segment IX dorsal strap; membranous, with ejaculatory duct sclerotised within; duct tubular, straight, originated from expanded, indistinct bulb (Fig. 51).

Female genitalia. (Specimen from Galwey Bk, Highway 6, just north of Waterton National Park boundary, Alberta). Tergum VII posterior border with ovoid, closely spaced markings (Fig. 54); sternum VII with similar, linear, markings on posterior border. Segment VII with massive, rectangular in lateral aspect, tergum, and small, triangular, indistinct sternum; sternum, in ventral aspect, broadly dishd (Fig. 53). Ventral portion of segment IX of two triangular lobes, dark, with ventro-lateral folds; dorsal portion short, sclerotised, free of ventral lobes, attached to postero-dorsal edge of tergum VIII; with segment X imperceptibly attached distally. Segment X membranous, ventrally concave, with disto-ventral hook; triangular in ventral aspect with thin lateral walls. Vulval scale set dorso-mesad of ventro-lateral lobes of segment IX; black, with latero-anterior pockets directed antero-ventrad within segment VIII; distally bifid, with lateral processes hooked mesad in ventral aspect; mesad of lobes a circular cleft; ventrally concave.

Notes on habitat and activity period. — All specimens available to me were taken from three localities on two consecutive days. The localities were: a quiet, small, gravel-bottomed creek draining large sedge bogs; a larger stream (about 30' wide) with gravel and larger rock bottom; and a full-sized river (about 150') running through a gorge, over boulder bottom. This species appears to have a wide latitude in its choice of streams. Dates of capture were September 4 and 5.

When collecting specimens of this species, I encountered a habit previously unknown to me in Trichoptera. The adults rested on the substrate (concrete culverts) with all feet on the surface. However, the body, and consequently the wings, were raised from the surface at an angle of about 20° or more, with head down. This simplified picking them up by hand, as they also had the unusual habit, in culverts at least, of resting low down, close to running water.

Geographical distribution. — This species is reported from British Columbia and Alberta south to California in the west, and to Idaho and Montana in the east (Fig. 115). In Alberta it is known only from the south-west corner of the Province, from the Oldman River south to Waterton National Park. It appears to be a species of the eastern fringes of the Foothills. Known altitude range is from 4,100' to 5,000'.

I have examined 11 specimens of this species from the study area: four males; seven females.

The Subfamily Limnephilinae Ulmer
The Tribe Limnephilini Schmid
The Genus *Limnephilus* Leach
The *subcentralis* group
Limnephilus nimmoi Roy and Harper, 1975
(Fig. 64-70, 116)

Limnephilus species 1; Nimmo, 1971a: 94-95, 203, 208, Fig. 296-297, 612.

Limnephilus nimmoi Roy and Harper, 1975: 1083, 1085-1088, Fig. 1-4, 7-8. (Type locality: Lac Monroe, Mt. Tremblant Park, Québec).

Males of this species are distinguished by segment X lobes long, projected posterad of cerci, straight, tapered distally (Fig. 64); by cercus with distinct ventral edge beyond body of segment IX; by substantial (in lateral aspect) dorsal strap; and by distinct black tooth on dorso-lateral face of clasper tip. Females are distinguished by large dorsal body of segment IX; by long, distally up-turned segment X; and by long, slender, tapered cerci not appressed dorsally to Segment X (Fig. 69).

Description. — Antennae yellow-brown. Vertex of head, thorax, legs yellow-brown; warts paler, to white. Fore-legs of male with brush a single row of minute dark spines along basal portion of postero-mesal edge of femur. Middle, hind-legs with strong, dark setae on tibiae. Fore-wing length of male 11.52 mm; yellow-brown overall, with hyaline areas in pattern typical of the *sublunatus* group. Stigma virtually indistinguishable. Venation typical as for *Limnephilus* generally.

Male genitalia. (Specimen from Lac Monroe, Mt. Tremblant Provincial Park, Québec. Paratype). Tergum VIII with slight postero-dorsal spinate process (Fig. 64). Main body of segment IX with acuminate antero-ventral and posterior edges; dorsal edge produced postero-dorsad, with postero-ventral fold just dorsad of clasper; dorsal strap stout, angled posterad. Clasper delineated from segment IX, with short postero-dorsal projection tapered distad, with dorso-mesally directed black tooth (Fig. 64, 65). Cercus large, broad, curved posterad, with dorsal and ventral edges parallel in lateral aspect (Fig. 64); with straight distal edge; with various stout, strongly sclerotised teeth on mesal face (Fig. 65). Segment X of two black, stout (in lateral aspect) blades slightly longer than cerci; each blade with complexly folded ventro-lateral projections directed ventrad of cercal bases (Fig. 64, 65); with minute tooth just laterad of tip (Fig. 65, 66). Aedeagus very stout, short (Fig. 67); with median shaft slightly shorter than lateral arms, strongly tapered, with distinct head; lateral arms massive, with fleshy, erectile distal one-third fringed dorsally by heavy, dark spines; with massive dorsally directed, triangular blade at dorso-distal angle of sclerotised portion of arm (Fig. 68).

Female genitalia. See Nimmo, 1971a: 95 for full description; and Fig. 69, 70 of this paper.

Notes on habitat and activity period. — I have taken a second female of this species in Alberta. The first record was from a small muskeg lake in the Athabasca R. valley south of Jasper. The second is from a similar lake, but well out in the lower foothills to the east, about 35 miles north of Nordegg, on the Forestry Trunk Road. The collection dates for Alberta are now July 18, and September 10. Roy and Harper (1975) give Québec collection dates ranging from July 19 to August 28.

Geographical distribution. — To date this species is only known from Canada (Fig. 116), with records only from Alberta and Quebec. The Alberta distribution suggests that the species is confined to lower altitudes, whether the mountain ranges, or in the Foothills.

The *picturatus* group
Limnephilus insularis Schmid, 1950
 (Fig. 59-63, 117)

Limnephilus insularis Schmid, 1950: 47-48, Fig. 1-4. (Type locality: Wellington, Vancouver Island). Schmid and Guppy, 1952: 42. Ross and Spencer, 1952: 48. Ross and Merkle, 1952: 449. Schmid, 1955: 136. Fischer, 1968: 198. Fischer, 1973: 85.

This species is distinguished by lack of spinate postero-dorsal edge of tergum VIII (Fig. 59); by long, triangular cerci, in lateral aspect, at angle of 45° ; by lobes of segment X almost as long as cerci, acute triangular, parallel to but ventrad of cerci in lateral aspect; and by clasper with minute dorsal process.

Description. — Antennae reddish brown, scape and pedicel markedly darker. Vertex of head deep chocolate-brown; frons slightly paler, with setal bases pale reddish cream; remainder of head pale yellowish brown, especially pair of warts along postero-dorsal edge. Thorax generally deep chocolate-brown, especially dorsally; paler laterally; warts and setal bases deep reddish straw coloured. Spurs yellow. Brush of male foreleg fairly discrete row of spines of mixed larger and smaller sizes, along only basal two-thirds of femur. Fore-wing length of male 9.92 mm; virtually hyaline, with faint brownish tinge faintly patterned to irrorate at distal quarter of wing; costal area quite clear; stigma a reddish brown thickening. Hind-wings about hyaline. Venation of male typical of *Limnephilus* species.

Male genitalia. (Specimen from bog at highest crossing of James R. by Forestry Trunk Road, Alberta). Tergum VIII unmodified. Segment IX main body in lateral aspect with slightly curved anterior edge (Fig. 59); widest dorsally, tapered broadly basad; dorsal strap substantial (Fig. 59, 61), with considerable dorso-ventral depth. Clasper delineated from segment IX, along full height of posterior edge, with slight, rounded, postero-dorsal process (Fig. 59, 60). Cercus, in lateral aspect, acute-triangular, directed postero-dorsad at 45° ; with small, conical tooth just basad of tip, on mesal face; with postero-ventral angle folded mesad (Fig. 60). Segment X of two sclerites, each with basal plate directed laterad, slightly convoluted; postero-dorsal process long, narrow, tapered distad, almost acuminate, with minute dentitions along distal 0.25 of dorsal edge; with slight lateral hook to tip (Fig. 61); generally darkly sclerotised, black on distal quarter. Small fleshy lobe meso-ventrad of segment X (Fig. 60, 61). Aedeagus with almost rectilinear median shaft (Fig. 62), with distinct distal head; lateral arms slightly shorter, broad in lateral aspect, with less coloured, expanded, leaf-like tip fringed with fine setae; with long, heavy setae directed meso-dorsad from area two-thirds distance from arm base (Fig. 62, 63), in part originated from small lobe projected mesad of distal expansion (Fig. 63).

Female. Unknown, or not yet associated.

Notes on life history and activity period. — The single specimen was taken by sweeping a bog of sedge in which there are areas of standing water of various depths. The bottom is generally firm, not quaking. Through the bog extends the upper reach of James R, which is deep, smooth-flowing, quite fast, with silt or clay bottom. *Equisetum* is scattered commonly through the sedge. Date of capture was September 22.

Geographical distribution. — This species is known from Vancouver Island to central British Columbia to the Alberta Foothills, south to Idaho (Fig. 117). Altitude of the Alberta locality is 4,900'.

I have one male of this species.

The *incisus* group
Limnephilus alvatus Denning, 1968
 (Fig. 71-77, 118)

Limnephilus alvatus Denning, 1968: 21-22, Fig. 7-7B. (Type locality: 'near Lethbridge', Alberta).

Males of this species are distinguished primarily by long, rounded process of postero-mesal angle of cercus (Fig. 71); also by long, very slender aedeagal lateral arms originated dorso-laterad on aedeagal base (Fig. 74). Females are very similar to those of *L. secludens* Banks, but may be distinguished by cercal lobes projected dorsad of segment X in lateral aspect (Fig. 76); and by ventral portion of segment IX distinct from dorsal portion.

Description. — Antennae reddish brown, as is remainder of body except vertex of head, legs paler. Spurs red-brown except fore-leg spur black. Brush of male fore-leg largely of fine, black spines intermingled with finer, shorter spines at edges; extended along distal three-quarters of femur, perpendicular to surface; tibia with corresponding brush of shorter, stouter

black spines directed distad. Male fore-wing length 9.76 mm; golden brown, extensively irrorate on distal, posterior portions; clear along costal area.

Male genitalia. (Specimen from 'near Lethbridge', Alberta. Holotype). Tergum VIII unmodified. Segment IX high, narrow in lateral aspect (Fig. 71), widest laterally, with dorsal strap heavy, angled posterad, black in continuation of black-bordered anterior edge of segment. Clasper inverted acute-triangular in lateral aspect; with wide base, rounded in posterior aspect (Fig. 73); claspers almost contiguous ventrally, converged at acute angle. Cercus prominent, horizontal, with postero-dorsal angle produced as rounded, tapered, finger-like lobe (Fig. 71, 72, 73); mesal face concave. Segment X bipartite, each part with basal plate from which originates a thin-bladed projection directed postero-laterad (Fig. 73), with small hook directed anterad in lateral aspect (Fig. 71). Aedeagus with sclerotised tubular base with strap originated from postero-dorsal edge directed postero-antegrad towards segment X (Fig. 74); median shaft long, slender, bowed ventrad, with distinct, large head (Fig. 74); lateral arms originated dorso-laterad of base of median shaft, almost as long as median shaft; thin, pale rods with small tuft of setae at tip (Fig. 75).

Female genitalia. (Specimen from about 10 miles southeast of Fairview, Alberta). Vulval scale lobes of equal length; median lobe fairly narrow, with rounded tip; lateral lobes rectangular, directed postero-laterad, away from median. Supragenital plate small, lightly sclerotised, with slight median extension posterad (Fig. 77). Segment IX with dorsal and ventral portions separate (Fig. 76); ventral portion triangular in lateral aspect; both sides broadly joined ventrally (Fig. 77); dorsal portion indistinguishably fused with segment X. Segment X tubular, with dorso-lateral edges bowed anterad. Cerci represented by short, broad-based, triangular lobes fused to dorso-lateral sides of segment X.

Notes on life history and activity period. — As I have not yet taken specimens of this species myself, I can say little. However, the known range adheres closely to the distribution of prairie in Alberta, wherein there are prairie outliers in the northwest and north centre of the Province. With the exception of the holotype from Lethbridge, however, all other material was obtained from light traps set out by Alberta Department of Agriculture to survey pest species of insects. These traps were located in agricultural areas, which occur predominantly in former prairie areas so that this apparent prairie distribution may be an artifact.

Geographical distribution. — To date known only from Alberta, from Lethbridge in the south, to Fort Vermilion in the far north (Fig. 118), and confined strictly to the Great Interior Plain. Altitude ranges from 900' to 3,000'.

Apart from the male holotype, I have examined a total of 40 specimens from the study area: 31 males; nine females.

Note on taxonomy. — When Denning described this species (1968) he included a female as allotype, taken at the same time and place. This female belongs to *L. janus* Ross. I examined the allotype of *L. alvatus* and illustrate it here (Fig. 78, 79). Comparison with my illustration of *L. janus* (Nimmo, 1971a: Fig. 383-384) will confirm the identity of the two. Until my 1971(a) paper, the female of *L. janus* had not been illustrated, though it was known — Milne (1935: 42) keyed what is clearly the female of the species known as *L. janus* (= *C. minusculus*), and Ross (1938b: 37) mentions the female of the species now known as *janus*. Finally, in my own collecting, I have independently associated the two sexes of *L. janus*. While *L. alvatus* and *L. janus* are placed in the same species group, so also is *L. secludens* Banks. The males of *L. alvatus* and *L. secludens* are very much closer to each other in appearance than either is to that of *L. janus*, though superficially these three species are very similar in general habitus. As indicated above, I found the correct female for *L. alvatus* by examination of light trap collections in which both sexes were found from the same collecting event, the female of *L. alvatus* very closely resembling that of *L. secludens*, as could be expected.

Limnephilus janus Ross, 1938
(Fig. 78-79)

Limnephilus alvatus; Denning, 1968: 21-22, Fig. 8-8c. (Female of *L. janus* Ross as allotype of *L. alvatus* Denning).

The *argenteus* group
Limnephilus vernalis Nimmo, new species
 (Fig. 80-84, 118)

Males of this species may be distinguished from those of *L. argenteus* Banks, the other species in the group, by clasper trapezoidal in lateral aspect (Fig. 80); by median lobes of segment X projected prominently posterad of cercus; by elliptical main body of segment IX in lateral aspect.

Description. — Antennae deep, warm, reddish brown; scapes darker, antero-mesal face pale, almost glabrous. Vertex of head varied from deep red-brown, to paler, with warts, setal bases very pale. Thorax generally red-brown, with darker areas. Brush of male fore-leg absent. Spurs deep straw-coloured; formula unknown, hind femora missing. Male fore-wing length 14.92 mm; warm red-brown, with scattered irrorations, larger hyaline areas especially at bases of cells f2, f3, and cell between, and around vein M1+2, and on either side of M at mid-point of wing length. Irrorations of costal area fused to produce larger hyaline areas. Hind wing hyaline except distal cells from costa to f3 very pale brown. Venation typical as for *Limnephilus* species.

Male genitalia. (Specimen from Grande Prairie, Alberta). Tergum VIII with slight projection of postero-dorsal edge as spinate lobe (Fig. 80). Segment IX roughly elliptical in lateral aspect, with main body merged dorsad with sharp-edged dorsal strap, tapered gently ventrad. Clasper attached only at base of process, at point half height of posterior edge of segment IX; short, trapezoidal in lateral aspect; with toothed edges to concave mesal face (Fig. 81). Cercus rectangular in lateral aspect, with curved distal edge; bulky in posterior aspect (Fig. 81); with dorso-ventral ridge on concave mesal face. Segment X bipartite; each sclerite with long, tapered, up-turned tip on median lobe, with tip slightly bulbous, curved dorso-laterad (Fig. 80, 81, 82); brown; lateral plaque with convolute lateral edge (Fig. 80), and ventrally directed acuminate process (Fig. 81). Aedeagus originated from tubular sclerotised base; median shaft curved gently dorsad, with distinct head; lateral arms originated from dorso-lateral portion of membranous basal portion, with narrow proximal portion, expanded distad of mid-point as flared, thin, mesally concave blade (Fig. 83, 84); blade with distal acuminate point setose on dorsal edge; with other, dorsal, angle small, bulbous, setose; mesal face of blade with four stout, black setae.

Female. Unknown, or not yet associated.

Geographical distribution. — This species is known only from a single locality in Alberta (Fig. 118) at about 2,150'. Additional data are not available.

Holotype. — Male. Grande Prairie, Alberta; 25/6/75; Alberta Department of Agriculture light trap.

The holotype is in the Canadian National Collection, Ottawa, with type number 15,164.

Unassociated females
Limnephilus species 2
 (Fig. 91-92, 119)

The single female is similar to females of *L. femoralis* (Kirby), but may be distinguished by cerci and distal projections of segment X tube in lateral aspect (Fig. 91) well separated vertically; and by segment IX in lateral aspect parallelogram-like. Illustrations of *L. femoralis* for comparison are to be found in Nimmo, 1971a: Fig. 335-336.

Description. — Antennae warm red-brown; scapes, pedicels darker. Vertex of head very dark brown, almost black. Thorax very dark brown dorsally, with dark and paler brown areas laterally. Spurs dark straw-colour; formula 1,3,4. Fore-wing length of female 13.12 mm; warm red-brown, with hyaline areas of various sizes from simple irrorations to larger, hyaline areas in bases of cells f2, f3, the cell between these, on either side of vein M1+2, and on either side of M about half way along wing length; costal area clear, with pale red-brown cast. Hind wing clear, but with very pale red-brown cast. Venation typical as for *Limnephilus* species.

Male genitalia. Unknown, or not yet associated.

Female genitalia. (Specimen from Three Hills, Alberta). Vulval scale (Fig. 92) with three lobes of equal length; lateral lobes curved, from common base with median lobe to oppose median lobe tip; median lobe truncated acute-triangular. Segment IX in lateral aspect (Fig. 91) parallelogram-like, dorsad of large membranous lobe; ventral portion wide (Fig. 92), orientated vertically under segment X (Fig. 91). Supragenital plate short (Fig. 91), narrow, weakly sclerotised (Fig. 92). Cercus acute-triangular in lateral aspect. Segment X with deeply separated acuminate dorsal lobes; with scoop-like single ventral lobe.

Notes on habitat and activity period. — The single specimen is another product of the Alberta Department of Agriculture light trap, and I can, therefore say little about the probable

habitat. The Three Hills area is in the open plains of Alberta, with scattered bodies of water (small lakes and sloughs, and occasional small streams). Date of capture was 23/6/76.

The locality of collection of the single female is shown in Fig. 119, at about 2,800'.

The Genus *Asynarchus* McLachlan
Asynarchus lapponicus (Zetterstedt), 1840
(Fig. 85-90, 119)

Phryganea fusca var. *b. lapponica* Zetterstedt, 1840: 10. (Type locality: Lapland).

Asynarchus lapponicus; Schmid, 1954: 78-81, Fig. 15-17. Schmid, 1955: 154. Clifford, 1969: 582. Fischer, 1969: 47-50.

Nimmo, 1971a: 132. Fischer, 1973: 111. (See Fischer, 1969: 47-48, and 1973: 111 for palaearctic literature).

Limnephilus lapponicus; Ross and Merkley, 1952: 443.

Anabolia modesta Hagen, 1861: 265. (Type locality: Labrador). Hagen, 1864: 804. McLachlan, 1876: 9. Banks, 1892: 363.

Banks, 1897: 28. Ulmer, 1905: 20. Ulmer, 1907: 48. Kolbe, 1912: 41. Betten *et al.*, 1934: 354-355. Milne, 1935: 43, 49.

Stenophylax modesta; Banks, 1907: 39.

Anisogamus modestus; Banks, 1930: 128

Limnephilus modestus; Ross, 1938b: 37, Pl. 7 Fig. 65-65A. Ross, 1944: 298.

Asynarchus modestus; Fischer, 1969: 49. (See Fischer, 1969: 49 for palaearctic literature).

Stenophylax fusorius McLachlan, 1875: 114, 116-117, Pl. 12 Fig. 1-3. (Type locality: Lapland). (See Fischer, 1969: 48 for palaearctic literature).

Anabolia (Asynarchus) fusorius; (See Fischer, 1969: 48 for palaearctic literature).

Anabolia fusorius; Banks, 1916: 122.

Asynarchus fusorius; Fischer, 1969: 48-49. (See Fischer, 1969: 48-49 for palaearctic literature).

Limnephilus rhanidophorus Wallengren, 1879: 274-275. (Type locality: Scandinavia).

Asynarchus rhanidophorus; Fischer, 1969: 50.

I reported the presence of this species in the study area in paper I of this series (Nimmo, 1971a: 132), as a brief note. Specimens are still not available from the study area, but I obtained specimens from Baffin Island from which to make the illustrations.

Males are distinguished by segment X without projected median lobes (Fig. 89); and by ventral process of cercus curved smoothly into poster-ventral edge of clasper in lateral aspect. Females are distinguished by segment X dorsal lobes as vertical, thin plates projected little posterad of segment IX (Fig. 89,90); and by anal tube not cleft in horizontal plane (Fig. 89).

Description. — Antennae red-brown, paler inter-annular sutures; scape, pedicel darker. Vertex of head very dark red-brown, warts slightly paler. Thorax very dark red-brown overall. Brush of male fore-leg much reduced, of scattered, fine setae on basal quarter of femur. Spurs yellow. Fore-wing length of male 12.46 mm; deep yellow-brown; costal area much paler than remainder; very faint irrorations throughout remainder of wing. Hind-wing hyaline with faint reddish tinge. Venation typical as for *Limnephilus* spp.

Male genitalia. (Specimen from Lake Harbour, Baffin Island, N.W.T.). Tergum VIII unmodified; posterior border paler than remainder (Fig. 85). Segment IX large; anterior edge black-bordered; segment longest laterally, smoothly constricted dorsad to vertical, stout dorsal strap. Clasper not clearly distinguished from ventro-lateral portion of posterior edge of segment IX; dorsal process in lateral aspect distally cleft to two black, acuminate processes; ventral process directed dorso-mesad (Fig. 86). Cercus massive, tapered dorso-posterad, with ventral pad-like lobe or tooth (Fig. 85, 86); with disto-mesal tooth (Fig. 87); entire posterior edge black; dorsal edges of claspers parallel, with opposed straight portions mid-way from base (Fig. 87). Segment X small, bipartite (Fig. 86), with thin, tenuous mesal bridge; lateral sclerites orientated in line from dorso-lateral to ventro-mesal. Aedeagus with median shaft curved ventrad then dorsad (Fig. 88), with distinct head mounted below centre-line of curve; lateral arms curved as median shaft, distally bifid, with dorso-anteriorly directed dorsal lobe; with rounded distal lobe projected posterad, with fringe of long setae; dorsal lobe acuminate, with two stout distal spines.

Female genitalia. (Specimen from Lake Harbour, Baffin Island, N.W.T.). Sternum VIII with ventro-lateral process concave (Fig. 89). Vulval scale triangular in ventral aspect (Fig. 90); median lobe slightly longer than lateral lobes, rectangular; lateral lobes triangular. Supragenital plate minute, broadly bell-shaped in outline. Segment IX, in lateral aspect, of triangular dorsal part, massive, irregular ventral part, with indistinct anterior edges; ventral parts fused narrowly ventro-mesally (Fig. 90). Segment X fused solidly to IX, vertical (Fig. 89), slightly grooved down posterior face (Fig. 90); with anal tube clearly segregated ventrally, simple.

Notes on habitat. — Clifford (1969) describes the single known Alberta locality as a brown-water stream of low velocity, with silt, mud, or grit bottom. To judge from the known distribution, this is a species of the northern forest and tundra, probably living in the slower streams, and muskeg ponds and lakes. Altitude of the single locality is about 2,800'.

Geographical distribution. — I have three records for this holarctic species in Canada: Nova Scotia; Alberta; and Baffin Island (Fig. 119).

I examined only a male and a female of this species, from Baffin Island.

The Genus *Lenarchus* Martynov
The Subgenus *Prolenarchus* Schmid

Three subgenera of *Lenarchus* are now known from the study area with the discovery of *L. (P.) keratus* Ross. The following characterisation of the subgenus *Prolenarchus* is abridged in translation from Schmid, 1955: 162.

Fore-wings large, rounded apically; uniformly finely speckled grey; hind-wings little larger in area. Male segment IX dorsally convex, short, not overhanging appendages; ventrad of dorso-posterior border two small, strongly sclerotised, spur-like hooks mesad of cerci, fused to each other basally. Cerci characteristic, concave on mesal face, uniformly sclerotised. Male segment X large, projected posterad, directed postero-dorsad; lateral flanges massive, solidly joined to median processes. Claspers fused to segment IX, not projected, appearing as part of segment postero-ventral edge. Aedeagus slender, sclerotised; lateral arms slender, distally expanded as concave, setose blade, with small disto-ventral process. Female segment IX short, of one piece; appendages long, slender, cylindrical. Segment X well developed, with two small processes dorso-laterad, similar to those of segment IX, but more slender. Supragenital plate large, horizontal. Vulval scale large, with oblique lateral lobes.

Lenarchus keratus (Ross), 1938
(Fig. 93-97, 117)

Limnephilus keratus Ross, 1938a: 165-166, Fig. 104. (Type locality: Thunder Bay, Ontario). Ross, 1944: 298.

Lenarchus keratus; Ross and Merkley, 1952: 437. Schmid, 1952: 172-173, Fig. 9-10. Schmid, 1955: 162. Etnier, 1968: 191.

Fischer, 1969: 68. Fischer, 1973: 115. Roy and Harper, 1975: 1083.

There is only one other species recognised in this subgenus, which is found only in northern Europe. *L. keratus* is distinguished immediately from other Limnephilidae in the study area by paired, black horns projected posterad from ventrad of Segment IX dorsal surface (Fig. 93).

Description. — Antennae dark red-brown with basal portion of annuli paler. Vertex of head dark red-brown, warts paler. Thorax dark red-brown dorsally, paler laterally. Brush of male fore-leg a single line of fine, even hairs except widened basad. Spurs dark red-brown; formula 1,3,4. Male fore-wing length 15.36 mm; dark chocolate-brown, costal area clear except faint patches of colour; remainder finely irrorate. Venation typical as for *Limnephilus* species.

Male genitalia. (Specimen from about 10 miles south-east of Fairview, Alberta). Segment IX massive, with very long tergal area in lateral aspect (Fig. 93), with narrow sternal area; anterior border lined with black. Clasper triangular in lateral aspect, dorsal, distal angles rounded; base solidly fused to segment IX; each clasper connected ventrally by small humped bridge, dorsally by faint sclerotised strap (Fig. 95). Cerci ventrad of postero-dorsal projection of segment IX; short, irregular, rounded in lateral aspect; in posterior aspect (Fig. 95) concave, with black, well defined 'wall' around lateral, dorsal edges; ventral edge straight, thin-walled. Segment X basal sclerites ventrad of cerci; large, rounded, dorsally concave; median lobes large, directed dorsad, tip hooked anterad, black; membranous anal lobe meso-ventrad of segment X. A pair of black, slightly divergent, tapered, somewhat blunt horns located under projection of segment IX, dorsad of dorso-mesal angles of cerci (Fig. 93, 94, 95); curved postero-ventrad. Aedeagus fairly massive, with thick median shaft with distal head partly recessed into tip (Fig. 97); lateral arms heavy, originated dorso-laterad of aedeagal base, expanded distally to concave, thin-walled tip; with dorsal edge of expansion with fringe of heavy, black setae (Fig. 96, 97); with stout, long, dentate process originated from mesal surface.

Female. Unknown, or not yet associated.

Note on habitat. — I am unfamiliar with the single Alberta locality except that it is in the Peace River outlier of the Prairie, which is heavily agricultural and flat except for the incised river valleys. The type of water body it inhabits cannot be determined at present. Altitude of collection point is about 2,000'.

Geographical distribution. — For many years after Ross described it, this species was known

only from the area around Lake Superior. Roy and Harper (1975) recently recorded a male from southern Québec. The Alberta record represents a westward extension of the range of about 1,500 miles (Fig. 117).

I examined a single male of this species.

The Genus *Platycentropus* Ulmer

This is the second limnephilid genus recorded in this paper as new to the study area. The following characterisation is abridged in translation from Schmid, 1955: 164-165.

Head short, eyes large, prominent; cephalic warts very small. Maxillary palpi long, massive; in male first article half length of second, which is as long as scape. Spur formula 1,3,3; meso-apical spurs of hind leg modified. Wings large; hind-wings little smaller than fore. Fore-wing with large brown areas. Venation of fore-wings with large discoidal cell clearly longer than petiole; chord disrupted, concave towards abdomen, roughly parallel to it; cell f5 often pointed; vein A2 with basal half absent. Male segment VIII unmodified. Genital capsule generally not prominent, a rigid, massive assemblage due to conspicuous development of segment IX; dorsally segment IX with single process, or two strongly sclerotised points dorsad of remainder of genitalia; laterally segment IX strongly constricted, considerably enlarged latero-ventrad, such that distal aperture and appendages directed postero-dorsad. Cerci in most males as massive, horizontal spurs; thick, heavily sclerotised. Lateral extensions of segment X large, horizontal spurs; thick, heavily sclerotised. Lateral extensions of segment X large, horizontal, often concave ventrad. Claspers small, not projected, with no free part. Aedeagus not large, median shaft slender, often wrinkled basally; lateral arms varied, in some males shortly spiniform, in others long, setiform. Female tergum IX long, stout, continuous with segment X which has free appendages. Ventral lobes of segment IX small, slender, as short, transverse plates. Vulval scale with long, thin, median lobe; with narrow, subquadrangular lateral lobes. Supragenital plate small, short.

Platycentropus plectrus Ross, 1938

(Fig. 98-101, 120)

Platycentropus plectrus Ross, 1938a: 169-170, Fig. 111. (Type locality: Honor, Michigan). Ross, 1944: 297. Leonard and Leonard, 1949a: 4, Pl. 3 Fig. 3. Leonard and Leonard, 1949b: 16, Fig. 1. Schmid, 1952: Fig. 3. Schmid, 1955: 166. Fischer, 1969: 71. Fischer, 1973: 116.

Hylepsyche plectrus; Banks, 1943: 350. Fischer, 1969: 71.

Males of this species are distinguished by black horns at lateral angles of postero-dorsal edge of segment IX (Fig. 98, 99, 100); by short, triangular lateral arms fused immovably to base of aedeagus (Fig. 101).

Description. — Antennae dull yellow-brown; scapes, pedicels paler. Vertex of head yellow-brown, mottled with darker brown patches. Thorax dark red-brown dorsally, yellow-brown laterally; legs yellow-brown. Brush of male fore-leg of straight, thin, black spines along basal half of femur mesal face, thinned out distad. Spurs dark yellow-brown. Hind-leg meso-apical spur flattened slightly, with fibrous flanges along opposite edges, not quite extended to spur tip. Male fore-wing length 12.55 mm; pale straw-coloured; with grey-brown areas posterad of M and M1+2, and R5, except area around basal half of M2 straw-coloured, and area between Cu2 and A straw-coloured. Hind-wing hyaline, with faint red-brown tinge to veins. Venation typical as for *Limnephilus* species, except male fore-wing with A2 very short, extended only to crossvein a1+a2.

Male genitalia. (Specimen from Hartley Ck, east side Athabasca R., opposite Ft. MacKay, Alberta). Tergum VIII with only sparse patch of long setae parallel to posterior border, set anterad of border (Fig. 98). Segment IX wide ventro-laterally, narrowly constricted dorso-laterally, markedly widened dorsad (Fig. 98); dorsal strap postero-dorsal edge with black horn at lateral angles; horns curved slightly mesad, strongly sclerotised (Fig. 98, 99, 100). Segment IX in posterior aspect inverted-triangular, with dorsal area bulged dorsad; posterior edge between horns sharply declivous, high; anterior edges in lateral aspect (Fig. 98) folded meso-posterad for most of height. Clasper short, rectangular in lateral aspect, ventro-laterad on posterior edge of segment IX; angled latero-ventrad in posterior aspect, both connected meso-ventrally by narrow strap (Fig. 99).

Cerci small, roughly rectangular in lateral aspect, directed posterad; oriented vertically in posterior aspect (Fig. 99); slightly concave on mesal face; with membranous base. Median lobes of segment X large, directed postero-laterad, tapered distad, with tips curved latero-dorsad; each with complexly folded basal sclerite, postero-ventral portion of which is deeply concave. Aedeagus small, short, stout, with large head telescoped into median shaft; lightly sclerotised; lateral arms reduced to small, triangular, immobile stubs set dorso-laterally on aedeagal base (Fig. 101).

Female genitalia. This sex is known for this species, but I was unable to obtain a specimen for illustration and description in time for this paper. See Leonard and Leonard (1949a: Pl. III Fig. 3) for an illustration.

Note on habitat. — I am not familiar with the single known study area locality. The single male from Alberta was taken in an emergence trap set in Hartley Ck, a locality well within the northern boreal forest. Date of capture was July 16.

Geographical distribution. — Recognition of this species represents a range extension of something over 1,000 miles to the west. The species was formerly known only from just south of the Great Lakes (Fig. 120). I also indicate the presence of the species in Saskatchewan. This is based on a male which I identified for D.H. Smith, University of Saskatchewan, in 1975, and which he took at some point north of Saskatoon, again in the boreal forest region. Alberta altitude 950'.

I examined two males from the study area.

The Tribe Stenophylacinae Schmid
The Genus *Philocasca* Ross
Philocasca alba Nimmo new species
(Fig. 102-105, 121)

This is the second species of *Philocasca* recorded from the study area.

This species is similar to *P. thor* Nimmo (1971a: 147), but males are distinguished by cerci angular, not projected beyond base of segment X median lobes, in lateral aspect (Fig. 102); by segment median lobes sinuate, not projected posterad in smooth curve; and by aedeagal lateral arms located along dorso-lateral surfaces of median shaft, massive, blade-like (Fig. 105).

Description. — Antennae pale yellow-brown; antero-mesal face of scape glabrous, paler; postero-mesal face white. Vertex of head pale red-brown, warts cream-coloured. All setae hyaline except black setae in row parallel to postero-lateral margin of compound eye. Thorax reddish brown to straw-coloured in parts dorsally, with cream-coloured warts; pale straw-colour laterally. Spurs red-brown; formula 1,2,4. Male fore-wing length 17.76 mm; milky opaque grey, with faint irrorations except costal area. Hind-wing uniformly opaque white. Venation little different than for *P. thor* Nimmo (1971a: Fig. 143 a-b), except discoidal cell closed distally on hind-wing by cross-vein r2-r3.

Male genitalia. (Specimen from Rowe Bk, 6,350', Waterton National Park, Alberta). Segment IX with broad, angular basal half tapered irregularly dorsad to substantial dorsal strap (Fig. 102); with black-bordered anterior and postero-dorsal edges; dorsal portion of segment interior sclerotised as paired, deep, anteriorly concave cups (Fig. 104) separated by rounded median ridge of medium height. Clasper short, button-like, fused ventrally with opposite clasper (Fig. 103), with dark band round basal area. Cercus short, angular, concave mesally (Fig. 102, 104); with postero-ventral edge free of segment IX, dorsad of membranous area (Fig. 102). Segment X paired sclerites apparently confluent laterally with cerci (Fig. 104); dorso-median process sinuate, tapered to thin, rounded tip projected well clear of remainder of segment; mesal faces of processes parallel. Aedeagus stout, with antero-lateral straps attached to sclerotised base (Fig. 105); median shaft short, stout, mostly membranous with distinct sclerotised head concave dorsally at which point ejaculatory duct opens; lateral arms very dark, curved dorso-posterad to lie along dorso-lateral surfaces of median shaft; tapered. Antero-dorsad of lateral arms a high, hood-like expansion of base, with posterior face concave, black.

Female. Unknown, or not yet associated.

Notes on habitat and activity period. — This is a species of higher altitudes, from the sub-alpine, and probably alpine, regions of the study area. I do not yet know if it frequents standing or running water areas as larvae; the possibility exists that, like other species, this is terrestrial as larvae. Dates of capture are May 11, May 27, and June 12.

Geographical distribution. — Known only from the southern mountains of Alberta (Fig. 121), close to the continental divide. Altitudes are 6,350', and 6,500'.

Holotype. — Male. Rowe Bk, 6,350', Waterton National Park, Alberta; 12/6/75; D.B. Donald.

Paratypes. — Twin Ck, Marmot Basin, west of Kananaskis R., Alberta, 11/5/76; R. Mutch;

two males. Same as preceding; 27/5/75; R. Mutch; three males.

I examined six males of this species. Wings, legs and antennae of the Twin Ck paratypes are damaged from the time of collection.

The holotype, and Twin Ck (11/5/76) paratypes are in the Canadian National Collection, Ottawa, type series number 15,165. The remaining three paratypes (Twin Ck, 27/5/76) are in the Department of Entomology, University of Alberta.

This species is named with reference to the overall greyish white colour, especially of the wings.

The genus *Psychoglypha* Ross

Two changes of name are noted with reference to my 1971(a) paper, necessitated by Denning (1970), as follows:

P. alaskensis (Banks); Nimmo, 1971a: 153-154, 212, Fig. 572-577, 659, Tab. 2, 3.
is changed to

P. subborealis (Banks), 1924. The references in Nimmo (1971a: 153) to *Platyphylax alascensis* Banks should be deleted as they refer to quite another species and genus. On p. 154, the references to *Psychoglypha alascensis* and *Psychoglypha alaskensis* should be placed after those to *subborealis*, as *alaskensis* and *alascensis* are now the synonyms.

P. ulla (Milne); Nimmo, 1971a: 154, 212, Fig. 578-581, 660, Tab. 2, 3.
is changed to

P. alascensis (Banks), 1900. References under *P. ulla* (Nimmo, 1971a: 155) are retained on basis of synonymy, but it is necessary to insert, prior to these, the following earlier references under the present name:

Halesus?alascensis Banks, 1900: 471, Pl. 28 Fig. 19, 20.

Halesus alascensis; Ulmer, 1905: 21. 1907: 70.

Chilostigma alascensis; Banks, 1907: 40. Banks, 1924: 441. Essig, 1926: 176.

Chilostigma alascense; Ulmer, 1932: 215, 217. Betten *et al.* 1934: 368. Milne, 1935: 35, 50. Fischer, 1969: 319.

Psychoglypha alascensis; Denning, 1970: 16, 17, 20, 22, Fig. 13, 13A, 14, 14A.

Psychoglypha prita (Milne), 1935 (Fig. 106-107)

Psychoglypha prita; Nimmo, 1971a: 152-153, Fig. 562-565.

Denning (1970) described and illustrated a female of this species. I provided description and illustrations for the male in my 1971(a) paper, and here provide description and illustrations of the female derived from Denning's specimen.

Females distinguished by postero-ventral lobe of segment IX projected posterad, ventrad of segment X (Fig. 106); and by lobe ventrad of segment IX indistinguishable from sternum VIII.

Description. — Habitus of female not significantly different from that of male, except body colouration pale yellowish brown, with no darkening except marginally on thorax.

Female genitalia. (Specimen from Rice Ck two miles above Salmon R., Idaho County, Idaho). Sternum VIII posterior edge produced posterad as large, rounded lobe in lateral aspect (Fig. 106). Vulval scale in ventral aspect (Fig. 107) massive, lateral lobes rectangular, with much smaller, acute-triangular median lobe only half length of laterals. Supragenital plate long in lateral aspect (Fig. 106), with lateral angles curved dorsad, with relatively straight posterior edge (Fig. 107). Segment IX main body rectangular in lateral aspect with antero-dorsally directed invagination from lower half of antero-lateral edge; lower half of postero-lateral edge produced as relatively acute-triangular lobes, finger-like in ventral aspect, ventro-laterad of segment X. Segment X small, tapered, with abrupt taper disto-ventrad; arched dorsad, with wide, trapezoidal cleft in distal edge, in ventral aspect; with prominent (Fig. 106), rounded lobe ventrad, between posterior lobes of segment IX.

Psychoglypha alascensis (Banks), 1900
(Fig. 108-109)

Psychoglypha ulla; Nimmo, 1971a: 155, Fig. 578-581.

The female was illustrated and described previously. Here I provide description and illustrations of a female from the study area taken in 1976. The male was described in my 1971(a) paper.

Females distinguished by massive postero-lateral lobes of segment IX projected posterad of remainder of genitalia; and by segment X almost totally enclosed by them in lateral aspect (Fig. 108).

Description. — Habitus not significantly different from that of male.

Female genitalia. (Specimen from Coppermine Ck, Red Rock Canyon Rd, Waterton National Park, Alberta). Sternum VIII projected posterad of tergum, ventrad of segment IX (Fig. 108). Vulval scale lateral lobes roughly trapezoidal, large, posterior edge angled postero-laterad, with minute, triangular median lobe (Fig. 109). Segment IX large, of one piece as roof-like structure over remainder of genitalia, with postero-lateral angles produced posterad to flank segment X; these lobes slightly demarcated from body of segment IX by shallow lateral declivity, abruptly narrowed dorsad to beak-like, tapered termination in lateral aspect (Fig. 108). Segment X ventrad of IX, trapezoidal in lateral aspect, concave ventrally, with large, semi-circular cleft in ventral aspect. Supragenital plate lunate in ventral aspect, prominent in lateral aspect, dominated by large fleshy lobe dorsad.

Placement of Genera and Species
of Limnephilidae new to Study Area, in Keys
previously constructed
The Genus *Dicosmoecus* McLachlan

- Male. Refer to key on p. 51 of Nimmo, 1971a. Add
1c. Mesal ridge of clasper base in posterior aspect not vertical, with clearly visible ventral ridge and dorso-lateral ridge irregular, thin-walled, high, black (Fig. 43) *D. gilvipes* (Hagen).
- Female. Refer to key on p. 52 of Nimmo, 1971a. Add
1c. Median lobe of vulval scale less than half length of laterals (Fig. 46), expanded disto-laterad, the projections housed in large concavities of lateral lobe mesal face; lateral lobes massive, fused dorso-mesally. Segment X short, triangular in lateral aspect (Fig. 45), shallowly cleft in ventral aspect (Fig. 46), with ventro-mesal lobes near junction with segment IX, directed mesad *D. gilvipes* (Hagen).

The Genus *Imania* Martynov

- Male. Refer to key on p. 56 of Nimmo, 1971a.
I. thomasi Nimmo, n. sp. keys to 2a wherein it may be distinguished by aedeagal base with second pair of processes basad of lateral arms, set dorsad, long, tapered, black (Fig. 58).

The Genus *Neophylax* McLachlan

Refer to key to genera of Neophylacinae in study area on p. 71 of Nimmo, 1971a. This key encompasses both sexes. Add

- 1c. Segment X of male of two or three pairs of elongated appendages (Fig. 47). Claspers projected, not telescoped into IX. Female segment IX lobes elongate, fused to lateral borders of vulval scale (Fig. 53)
. *Neophylax* McLachlan (*N. rickeri* Milne).

The Genus *Limnephilus* Leach

- Males. Refer to key on p. 83 of Nimmo, 1971a.
L. nimmoi Roy and Harper keys to 22a wherein it may be distinguished by mesal faces of cerci heavily toothed (Fig. 65, 66).
L. insularis Schmid keys to 25b wherein it may be distinguished by cercus long, triangular in lateral aspect (Fig. 59), with segment X median lobes long, tapered, acuminate, directed postero-dorsad.
L. alvatus Denning keys to 26 wherein it may be distinguished by aedeagal lateral arms as long as median shaft, sclerotised, with minute tuft of setae at tip; clasper triangular, vertically high (Fig. 71, 74).
L. vernalis Nimmo n. sp. keys to 15b wherein it may be distinguished by clasper trapezoidal in lateral aspect (Fig. 80). Also, segment X median lobes projected posterad of clasper extremity; segment IX spindle-shaped in lateral outline.
- Females. Refer to key on p. 86 of Nimmo, 1971a.
L. nimmoi Roy and Harper keys to 27a, where it is designated *L. species 1* (Fig. 69, 70, this paper).
L. alvatus Denning keys to 30a, wherein it may be distinguished by lateral lobes of segment X projected dorsad of segment in lateral aspect (Fig. 77).
L. species 2 keys to 9b wherein it may be distinguished by segment X dorsal lobes visually discrete from dorso-lateral lobes, acuminate (Fig. 91). Segment IX ventral junction vertical in lateral aspect (Fig. 91).

The Genus *Asynarchus* McLachlan

- Male. Refer to key on p. 129 of Nimmo, 1971a.
A. lapponicus (Zetterstedt) keys to 1b wherein it may be distinguished by segment X median lobes not evident in lateral aspect (Fig. 85), completely enclosed in segment IX.
- Female. Refer to key on p. 129 of Nimmo, 1971a.
A. lapponicus (Zetterstedt) keys to 1b wherein it may be distinguished by segment X vertical in lateral aspect (Fig. 89), of two parallel ridges (Fig. 90).

The Genus *Lenarchus* Martynov
The Subgenus *Prolenarchus* Schmid

- Males. Refer to key to genera and subgenera of Limnephilini on p. 83 of Nimmo, 1971a. This key refers primarily to males. This subgenus keys to 7 wherein it may be distinguished by segment IX dorsal strap produced only slightly posterad; with paired, black, curved hooks ventrad of edge (Fig. 93).
- Male. Refer to key on p. 135 of Nimmo, 1971a.
L. keratus Ross keys to 1 wherein it may be distinguished by no dorsal plate present – postero-dorsal edge of segment IX produced only slightly posterad (Fig. 93). Ventrad of segment IX postero-dorsal edge a pair of curved spines or hooks, black, stout, slightly joined basad, projected posterad (Fig. 93, 94).

The Genus *Platycentropus* Ulmer

- Males. Refer to key to genera of Limnephilini in study area on p. 83 of Nimmo, 1971a.

This key refers primarily to males.

This genus keys to 2 wherein it may be distinguished by meso-apical spur on hind-leg modified; flattened, with thin-walled flanges along edges, not quite to tip of spur.

P. plectrus Ross is the only species known from the study area.

The Genus *Philocasca* Ross

- Males.
- 1a. Cerci almost as long as segment X median lobes, smoothly rounded distally (Fig. 545 (Nimmo, 1971a)); lateral arms of aedeagus narrow, laterad of median shaft (Fig. 547 (Nimmo, 1971a)) *P. thor* Nimmo.
 - 1b. Cerci short, angular; segment X median lobes sinuate, projected well posterad of cerci (Fig. 102); lateral arms of aedeagus stout, blade-like, curved dorso-posterad along dorso-lateral faces of median shaft (Fig. 105, this paper) *P. alba* Nimmo n. sp.

The Genus *Psychoglypha* Ross

- Females. My original key (Nimmo, 1971a: 152) was to females of only two species. It is inadequate to provide separation for the four now known. Therefore, I here present a new key.
- 1a. Vulval scale lateral lobes posterior edges in line with each other (Fig. 571 (Nimmo, 1971a)) (Fig. 107, this paper) 2
 - 1b. Vulval scale lateral lobes posterior edges irregular, not in line (Fig. 577 (Nimmo, 1971a)) (Fig. 109, this paper) 3
 - 2a. (1a) Segment IX postero-lateral edges with small, rounded process; segment X mostly recessed into IX (Fig. 570 (Nimmo, 1971a)) *P. schmidi* Nimmo.
 - 2b. Segment IX postero-lateral edges with long, triangular process; segment X mostly projected clear of IX (Fig. 106, this paper) *P. prita* (Milne).
 - 3a. (1b) Segment X dorsad of segment IX postero-lateral lobes, which are short, triangular, rounded (Fig. 576 (Nimmo, 1971a)) *P. subborealis* ((=*alaskensis*)) (Banks).
 - 3b. Segment X ventrad of segment IX postero-lateral lobes, almost completely enclosed by them (Fig. 108, this paper); Segment IX lobes massive, with beak-like dorsal extension *P. alascensis* (Banks) ((=*ulla* (Milne))).

POST-GLACIAL ORIGINS, AND AFFINITIES OF THE FAUNA

As this paper presents oddments additional to the fauna recorded previously, I refrain from examining pre-Wisconsin affinities of the groups represented here.

Table 1 presents visually the known study area altitudinal distribution of the species recorded herein. This may be compared with the similar table for these two families in my previous paper (Nimmo, 1971a: Tab. 3). I refrain from drawing conclusions at this time as the material on which these distributions are based is, at best, scanty. Also, I hope, in the near future, to carry out a more detailed study along these lines.

Table 1. Altitudinal distribution of the species recorded in this paper, in the study area, based on adult records.

Species	Altitude						Range Pattern
	1,000'	2,000'	3,000'	4,000'	5,000'	6,000'	
<i>Limnephilus alvatus</i>	—	—	—	—	—	—	10
<i>Platycentropus plectrus</i>	—						11
<i>Lenarchus keratus</i>		—					11
<i>Limnephilus vernalis</i>		—					6(?)
<i>Rhyacophila vao</i>		—	—	—	—	—	1
<i>Limnephilus</i> sp. 2			—				10
<i>Asynarchus lapponicus</i>			—				12(?)
<i>Rhyacophila unimaculata</i>			—				6
<i>Neophylax rickeri</i>				—	—		4
<i>Rhyacophila milnei</i>				—	—	—	6
<i>Limnephilus insularis</i>					—		6
<i>Dicosmoecus gilvipes</i>					—		3
<i>Rhyacophila</i> sp. 3						—	6
<i>Rhyacophila</i> sp. 4						—	6
<i>Rhyacophila donaldi</i>						—	6
<i>Imania thomasi</i>						—	6
<i>Philocasca alba</i>						—	6
<i>Rhyacophila autumnalis</i>						—	6
<i>Rhyacophila simplex</i>						—	6

Post-Glacial origins of the Species recorded, relative to Study Area

Nimmo, (1971a: 201-204) presented a list of 12 range patterns exhibited by study area species, and a list of postulated post-glacial dispersal routes (p. 218). Relating the species dealt with here, to these lists, produces the following table:

Table 2. Species of Rhyacophilidae and Limnephilidae recorded in this paper from the study area, listed under range pattern to which each is assigned, and giving postulated dispersal routes.

Pattern Number	Species	Map Fig.	Post-glacial dispersal route
1	<i>Rhyacophila vao</i>	110	a
3	<i>Dicosmoecus gilvipes</i>	114	a
4	<i>Neophylax rickeri</i>	115	b
6	<i>Imania thomasi</i>	115	d
	<i>Philocasca alba</i>	121	d
	<i>Limnephilus insularis</i>	117	d
	<i>Limnephilus vernalis</i>	118	?
	<i>Rhyacophila unimaculata</i>	111	d
	<i>Rhyacophila simplex</i>	111	d

Table 2. (continued)

Pattern Number	Species	Map Fig.	Post-glacial dispersal route
6	<i>Rhyacophila donaldi</i>	114	<i>d</i>
	<i>Rhyacophila autumnalis</i>	112	<i>d</i>
	<i>Rhyacophila</i> sp. 3	113	<i>d</i>
	<i>Rhyacophila</i> sp. 4	113	<i>d</i>
10	<i>Limnephilus alvatus</i>	118	<i>f</i>
	<i>Limnephilus</i> sp. 2	119	<i>f</i>
11	<i>Limnephilus nimmoi</i>	116	<i>e</i>
	<i>Platycentropus plectrus</i>	120	<i>g</i>
	<i>Lenarchus keratus</i>	117	<i>g</i>
12	<i>Asynarchus lapponicus</i>	119	<i>e?</i>
	(But holarctic overall)		

Most of the probable dispersal routes assigned in table 2 are tentative, and the best that can be assigned in the circumstances. Apart from species here described as new, most of the remainder are too poorly known.

Dicosmoecus gilvipes, *Neophylax rickeri*, *Limnephilus alvatus*, and *Platycentropus plectrus* are the most certain, and require no further comment.

Rhyacophila vao is uncertain as either route 'h' or 'i' could be involved, although I favour the route ('a') assigned.

Asynarchus lapponicus presents difficulties as, in North America it appears to belong to range pattern 12, but the species as a whole is holarctic. It may be that the species was split during the glaciation, with one part south of the ice in North America. It appears to be, from the isolated North American records, a species of the boreal forest and tundra.

Limnephilus nimmoi is assigned to range 11 primarily for convenience at this time. Probably it exists, unrecognised, in collections under different names as it is easily confused with others of its species group. It may be northern boreal as suggested by Roy and Harper (1975), and belong to range pattern 8, or even 7.

Limnephilus vernalis cannot be placed as yet.

Range pattern 6 is primarily a catch-all category for those species known only from the study area, and immediately adjacent areas to the south and west, but which are poorly known. Many included species are isolated, high altitude forms and, thus, poorly collected. *Rhyacophila unimaculata* is peculiar in appearing to follow the Rocky Mountain Trench. Ross' (1965) conjecture that this species is the product of a glacial refugium in the Mt. Robson area now appears to be confounded — not only on the basis of its presently known range, but also due to the low altitudes which it appears to favour.

However, accepting table 2 at face value, and recognising the small number of species involved, the following percentages of species from each source area prevail:

From Cordillera south/west of the study area	— 12 spp.	63.1%
From central plains	— 2 spp.	10.5%
From eastern North America	— 2 spp.	10.6%
From North America as a whole, S. of ice	— 2 spp.	10.5%
Indeterminate	— 1 sp.	5.2%

These figures are close to those determined in my 1971(a) paper, which provides the following figures for the known fauna of Rhyacophilidae and Limnephilidae, of the study area. The

1971 figures are given first, followed by the present total (for space reasons figures are presented thus — species numbers: %):

From Cordillera south/west of study area	— 65(1*):61%	77:58.7%
From Alaska	— 6: 5%	6: 4.5%
From central plains	— 7: 7%	9: 6.8%
From eastern North America	— 9: 8%	11: 8.4%
From North America as a whole, S. of ice	— 24:18%	26:19.8%
Indeterminate	— 1:1%	2: 1.5%

* (1) refers to *Limnephilus* sp. 1 (Nimmo, 1971a), now recognised as *L. nimmoi* Roy and Harper in this paper. The former total for 1971(a) was 66. The percentage value is left as originally determined.

Finally, taking the figures from my 1974 paper, on the Glossosomatidae and Philpotamidae of the study area, we obtain the following tabulation, which includes the percentage values calculated for the four families so far worked up for the study area; values from the 1974 paper are given first, followed by cumulated values for the four families:

From Cordillera south/west of study area	— 10:63.6%	87:55.4%
From Alaska	— -	6: 3.8%
From central plains	— 1: 8.0%	17: 9.2%
From eastern North America	— -	11: 7.0%
From North America as a whole, S. of ice	— 1: 8.0%	34:21.6%
Indeterminate	— -	2: 1.2%

While most values are seen to oscillate about those determined in 1971(a), the notable changes with additional information are the decrease in proportion of the fauna attributable to the Cordillera south of the ice, and the increase in proportion attributable to transcontinental species. This trend may be expected to continue with the addition of information from families remaining to be dealt with, as they are, by and large, concentrated east of the Cordillera.

CONCLUSIONS

1. Compared with data in Nimmo (1971a), proportions of species, recorded in this paper, derived from various source areas post-glacially do not differ drastically, except that there are proportionately fewer derived from eastern North America.

2. Combining species numbers derived from these source areas, from the earlier paper, and this, results in little change in relative proportions except that relatively fewer are derived from the Cordillera south of the ice, and more are derived from eastern North America.

3. Addition of species of Glossosomatidae and Philpotamidae, considered in another paper produces much the same results, with accentuation of decrease in Cordilleran species, and increase of eastern North American species.

4. It is expected that this trend will continue with further work on other, as yet untreated, families in the study area, which are predominantly eastern (east of the Cordillera).

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Fig. 1d. Map of Alberta and eastern British Columbia, to show collecting localities not recorded in Fig. 1, 1a, 1b (Nimmo, 1971), or Fig. 1c (Nimmo, 1974).

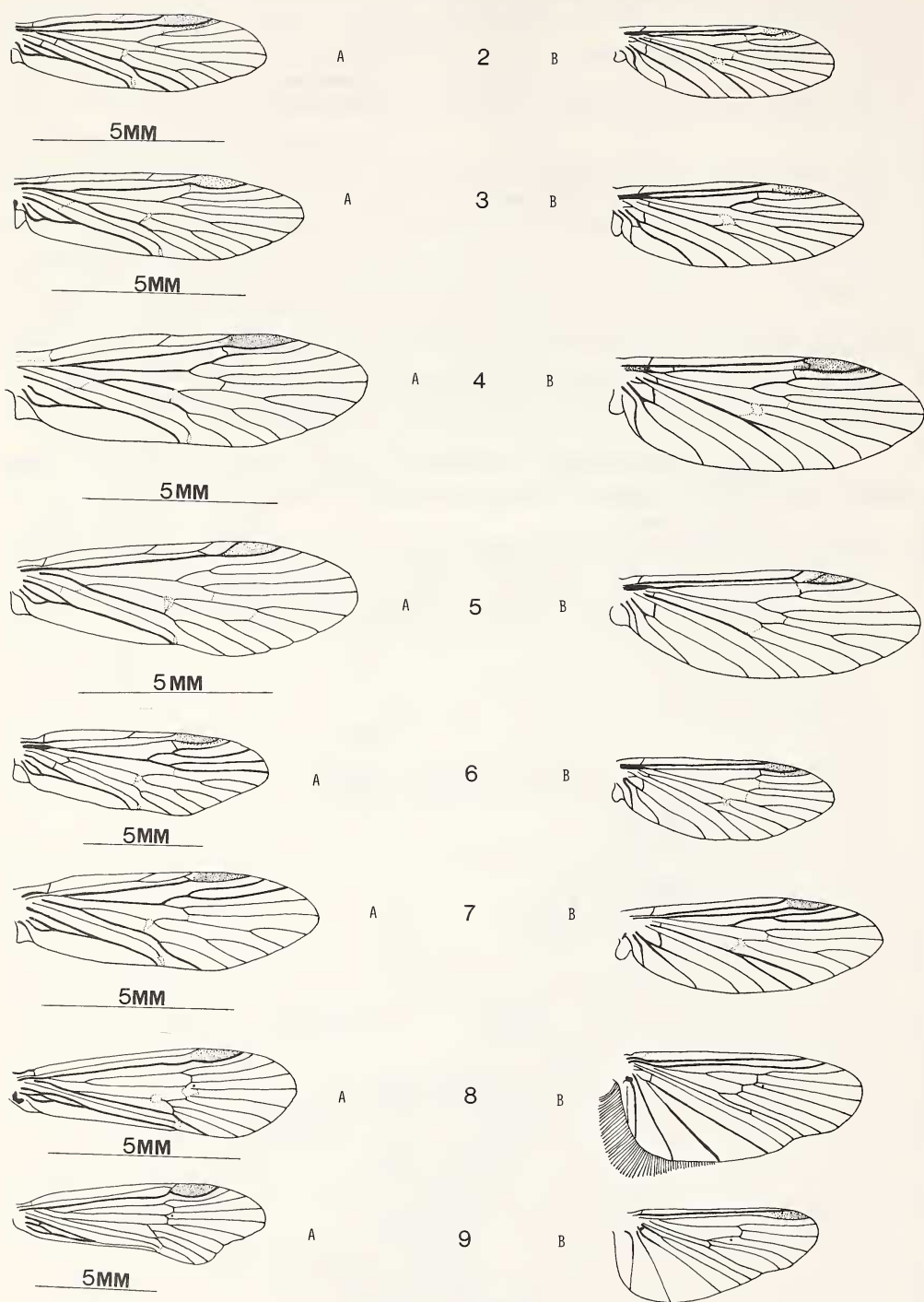


Fig. 2-9. Fore (a) and hind (b) wings of: 2. *Rhyacophila simplex* Nimmo n. sp. (male). 3. *R. donaldi* Nimmo n. sp. (male). 4. *R. donaldi* Nimmo n. sp. (female). 5. *R. autumnalis* Nimmo n. sp. (male). 6. *R.* species 3 (female). 7. *R.* species 4 (female). 8. *Imania thomasi* Nimmo n. sp. (male). 9. *Neophylax rickeri* Milne (Male).

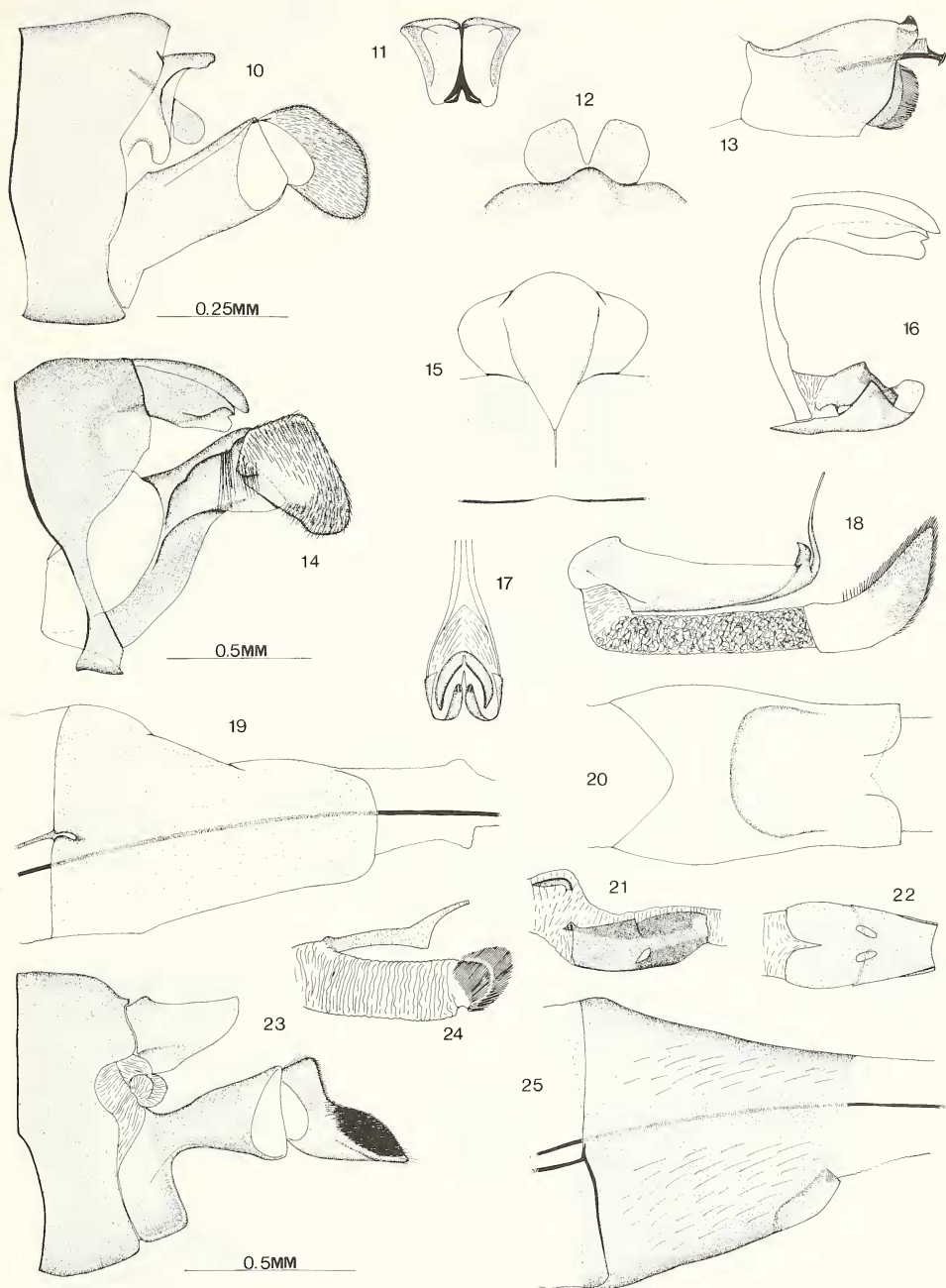


Fig. 10-25. Genitalia of: *Rhyacophila simplex* Nimmo n. sp. 10. Male, lat. aspect. 11. Seg. X, post. aspect. 12. Seg. X, dors. aspect. 13. Aedeagus, lat. aspect. *R. donaldi* Nimmo n. sp. 14. Male, lat. aspect. 15. Dors. aspect (Seg. IX, X). 16. Seg. X, anal sclerite, lat. aspect. 17. Anal sclerite, post. aspect. 18. Aedeagus, lat. aspect. 19. Female Seg. VIII, lat. aspect. 20. Seg. VIII, dors. aspect. 21. Spermathecal sclerite, lat. aspect. 22. Vent. aspect. *R. vao* Milne 23. Male, lat. aspect. 24. Aedeagus, lat. aspect. 25. Female Seg. VIII, lat. aspect.

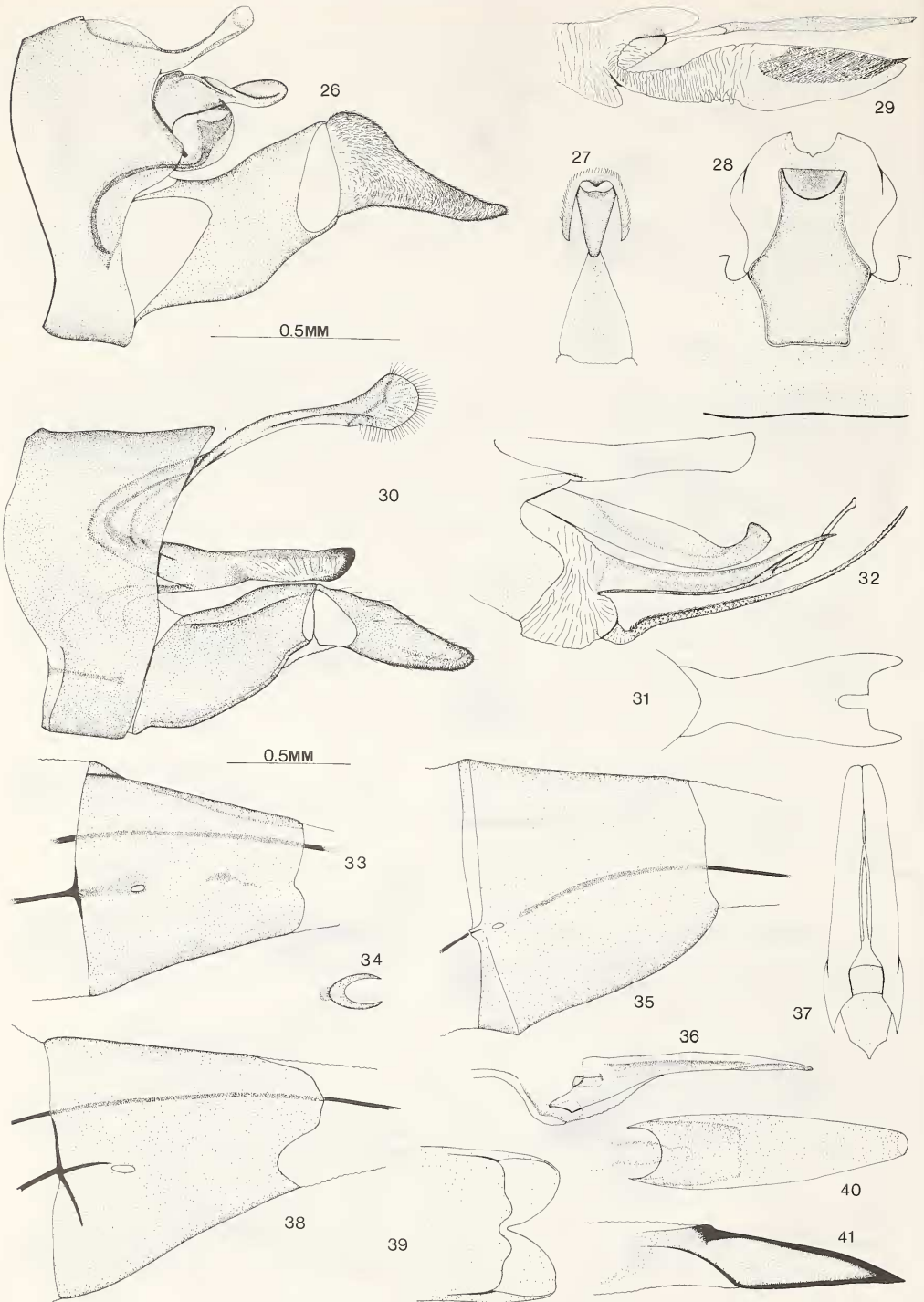


Fig. 26-41. Genitalia of: *Rhyacophila autumanlis* Nimmo n. sp. 26. Male, lat. aspect. 27. Anal sclerite, tergal strap, post. aspect. 28. Seg. IX, X, dors. aspect. 29. Aedeagus, lat. aspect. *R. unimaculata* Denning. 30. Male, lat. aspect. 31. Seg. X dors. lobe, dors. aspect. 32. Aedeagus, lat. aspect. *R. milnei* Ross 33. Female Seg. VIII, lat. aspect. 34. Spermathecal sclerite, ventr. aspect. *R. species 3*. 35. Female Seg. VIII, lat. aspect. 36. Spermathecal sclerite, lat. aspect. 37. Dors. aspect. *R. species 4*. 38. Female Seg. VIII, lat. aspect. 39. Seg. VIII post. edge, ventr. aspect. 40. Spermathecal sclerite, dors. aspect. 41. Lat. aspect.

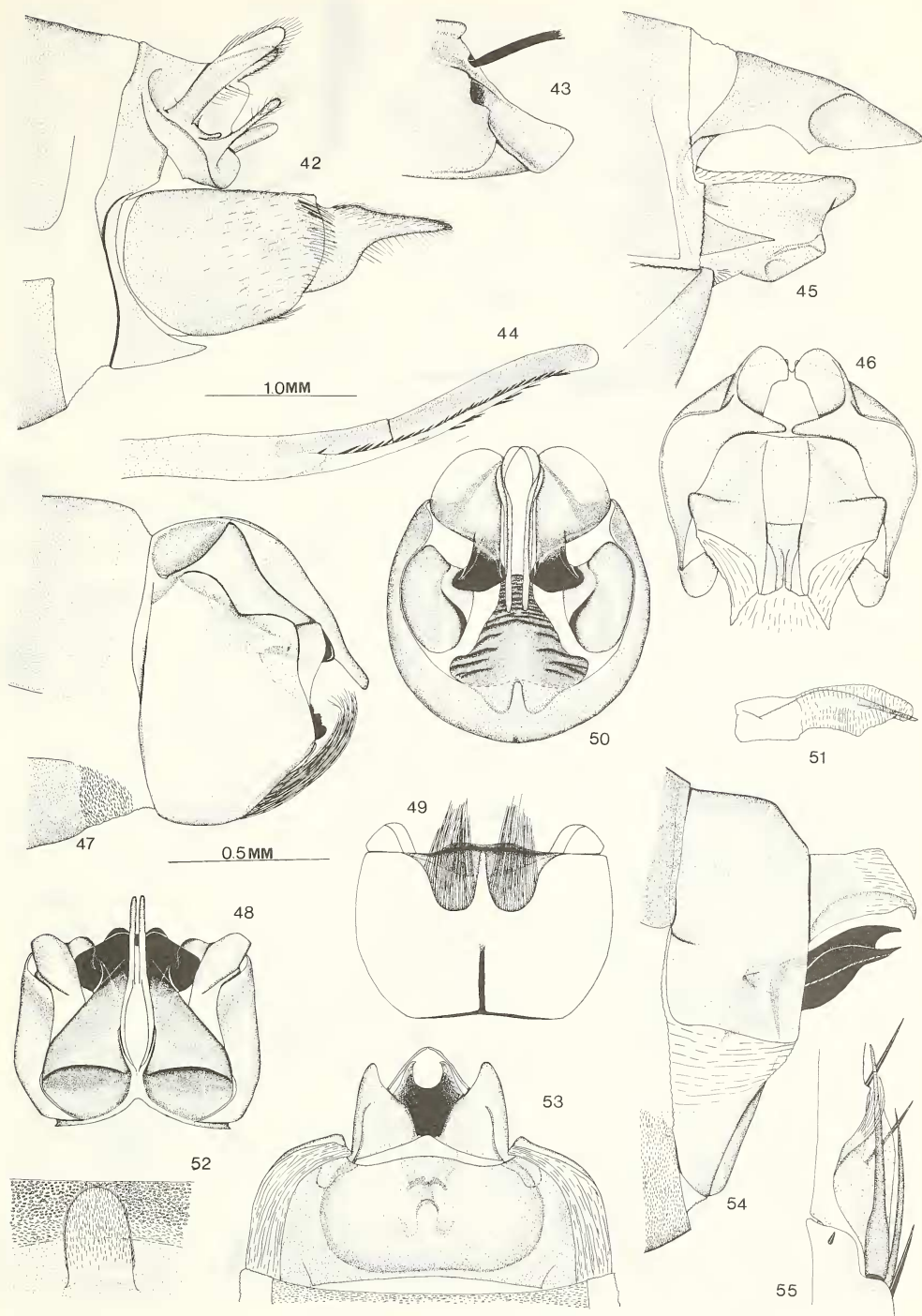


Fig. 42-55. Genitalia of: *Dicosmoecus gilvipes* (Hagen). 42. Male, lat. aspect. 43. Clasper basal seg. mesal face, post. aspect. 44. Aedeagus, lat. aspect. 45. Female, lat. aspect. 46. Ventral aspect. *Neophylax rickeri* Milne. 47. Male, lat. aspect. 48. Dors. aspect. 49. Ventral aspect. 50. Post. aspect. 51. Aedeagus, lat. aspect. 52. Sternum VII post. border, ventral aspect. 53. Female, ventral aspect. 54. Lat. aspect. 55. Male hind-tibia, distal spurs.

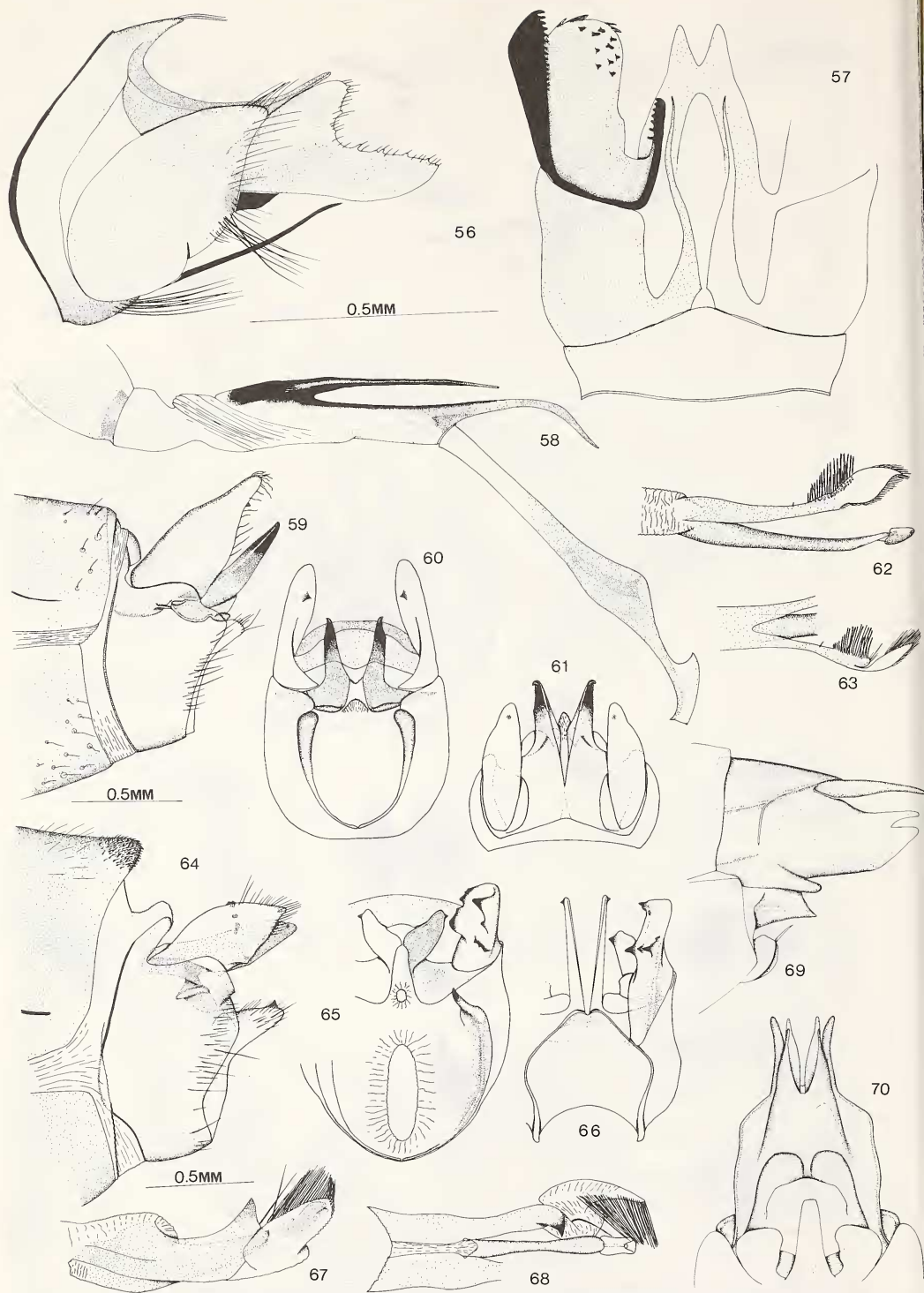


Fig. 56-70. Genitalia of: *Imania thomasi* Nimmo n. sp. 56, Male, lat. aspect. 57. Ventr. aspect. 58. Aedeagus, lat. aspect. *Linnephilus insularis* Schmid. 59. Male, lat. aspect. 60. Post. aspect. 61. Dors. aspect. 62. Aedeagus, lat. aspect. 63. Dors. aspect (part.). *L. nimmoi* Roy and Harper. 64. Male, lat. aspect. 65. Post. aspect (part.). 66. Dors. aspect. (part.). 67. Aedeagus, lat. aspect. 68. Dors. aspect (part.). 69. Female, lat. aspect. 70. Ventr. aspect.

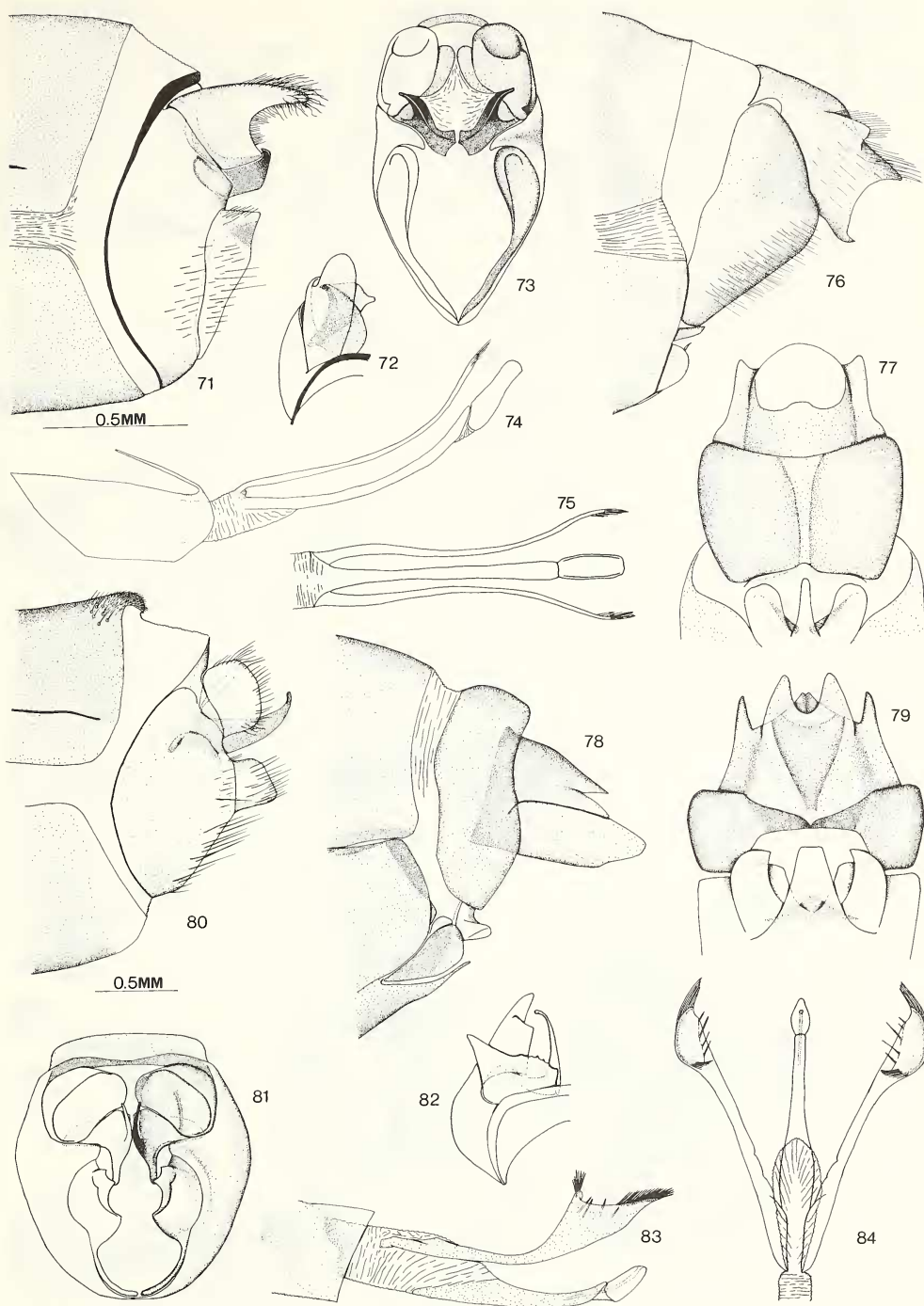


Fig. 71-84. Genitalia of: *Limnephilus alvatus* Denning. 71. Male, lat. aspect. 72. Dors. aspect. (part.). 73. Post. aspect. 74. Aedeagus, lat. aspect. 75. Dors. aspect. 76. Female, lat. aspect. 77. Ventr. aspect. *L. janus* Ross. 78. Female, lat. aspect. 79. Ventr. aspect. *L. vernalis* Nimmo n. sp. 80. Male, lat. aspect. 81. Post. aspect. 82. Dors. aspect. (part.). 83. Aedeagus, lat. aspect. 84. Dors. aspect.

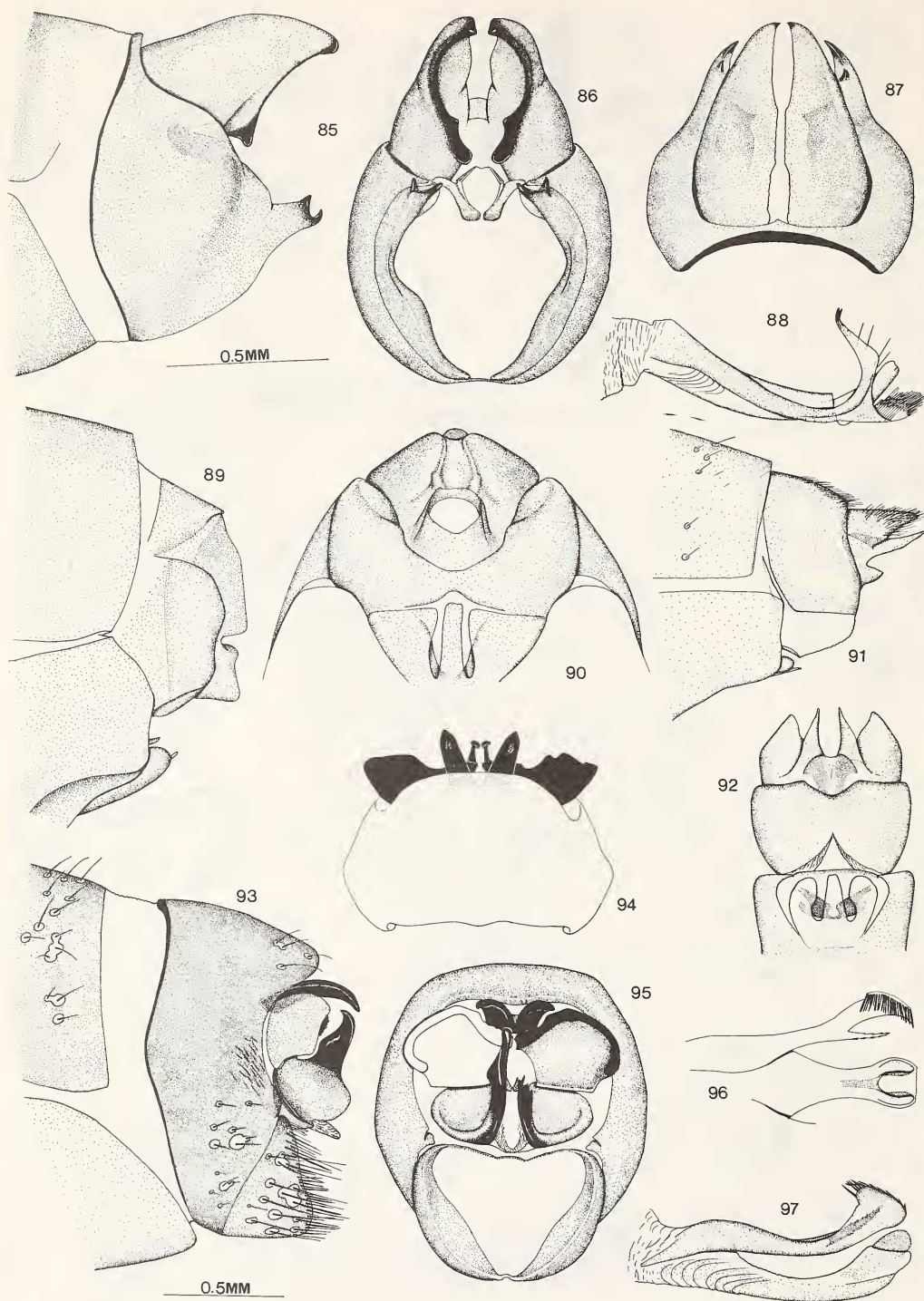


Fig. 85-97. Genitalia of: *Asynarchus lapponicus* (Zett.). 85. Male, lat. aspect. 86. Post. aspect. 87. Dors. aspect. 88. Aedeagus, lat. aspect. 89. Female, lat. aspect. 90. Ventr. aspect. *L. species 2*. 91. Female, lat. aspect. 92. Ventr. aspect. *Lenarchus keratus* Ross. 93. Male, lat. aspect. 94. Dors. aspect. 95. Post. aspect (part.). 96. Aedeagus, dors. aspect. 97. Lat. aspect.

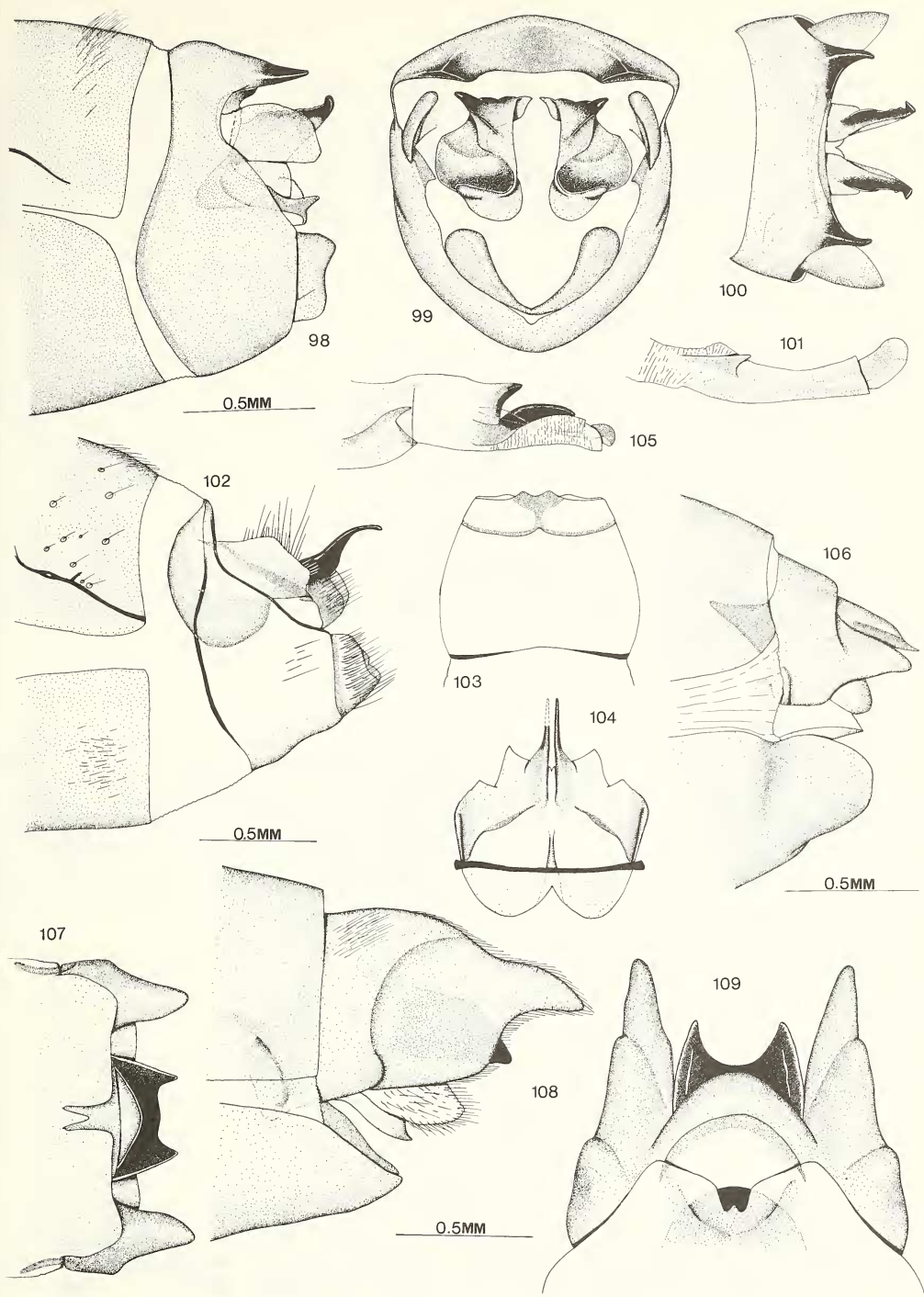


Fig. 98-109. Genitalia of: *Platycentropus plectrus* Ross. 98. Male, lat. aspect. 99. Post. aspect. 100. Dors. aspect. 101. Aedeagus, lat. aspect. *Philocasca alba* Nimmo n. sp. 102. Male, lat. aspect. 103. Ventr. aspect. 104. Dors. aspect. 105. Aedeagus, lat. aspect. *Psychoglypha prita* (Milne). 106. Female, lat. aspect. 107. Ventr. aspect. *P. alascensis* (Banks). 108. Female, lat. aspect. 109. Ventr. aspect.

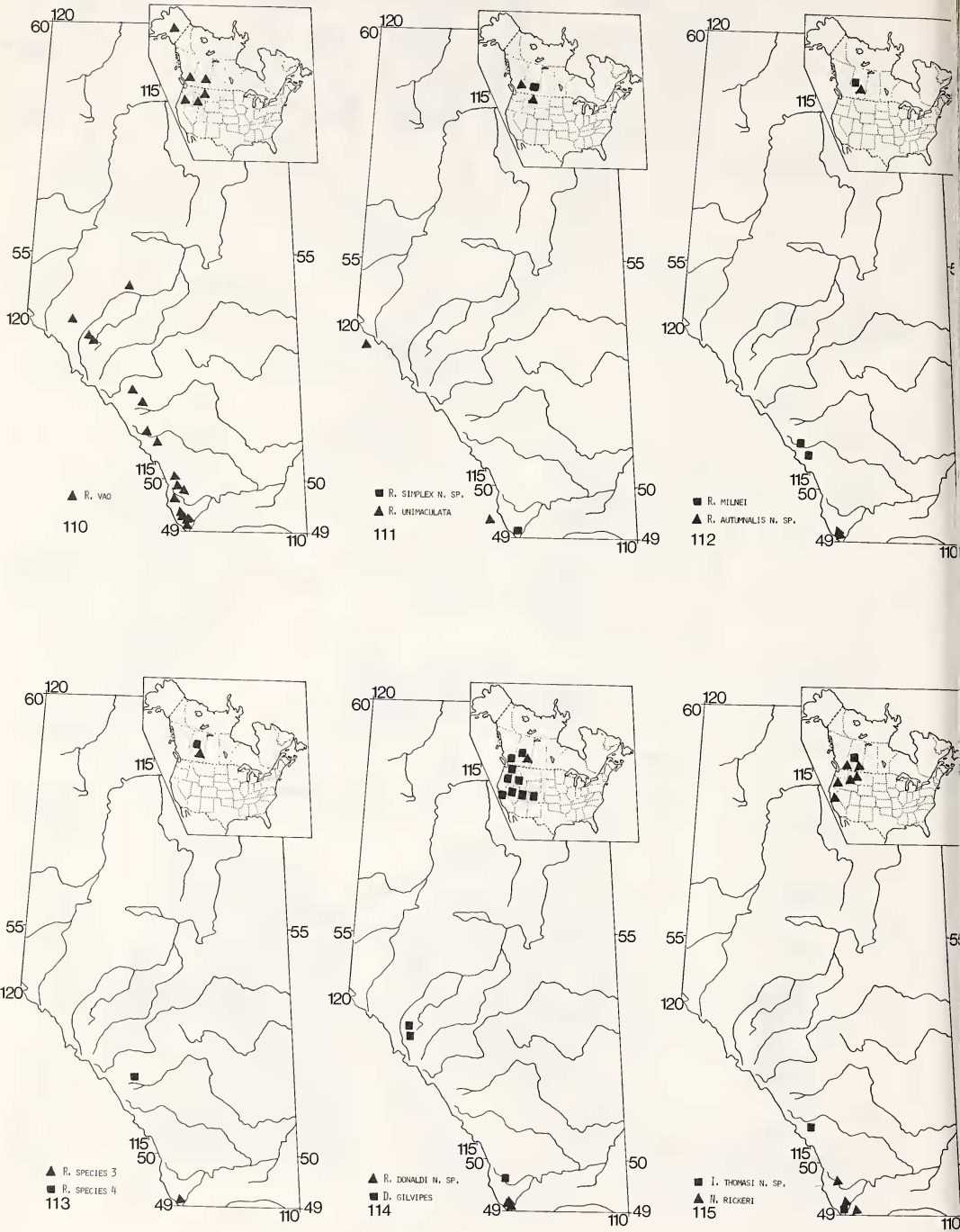


Fig. 110-115. Maps of distribution in Alberta & North America of: 110. *Rhyacophila vao* Milne. 111. *R. simplex* Nimmo, n. sp., *R. unimaculata* Denning. 112. *R. milnei* Ross, *R. autumnalis* Nimmo n. sp. 113. *R. species 3*, *R. species 4*. 114. *R. donaldi* Nimmo n. sp., *Dicosmoecus gilvipes* (Hagen). 115. *Imania thomasi* Nimmo n. sp., *Neophylax rickerti* Milne.

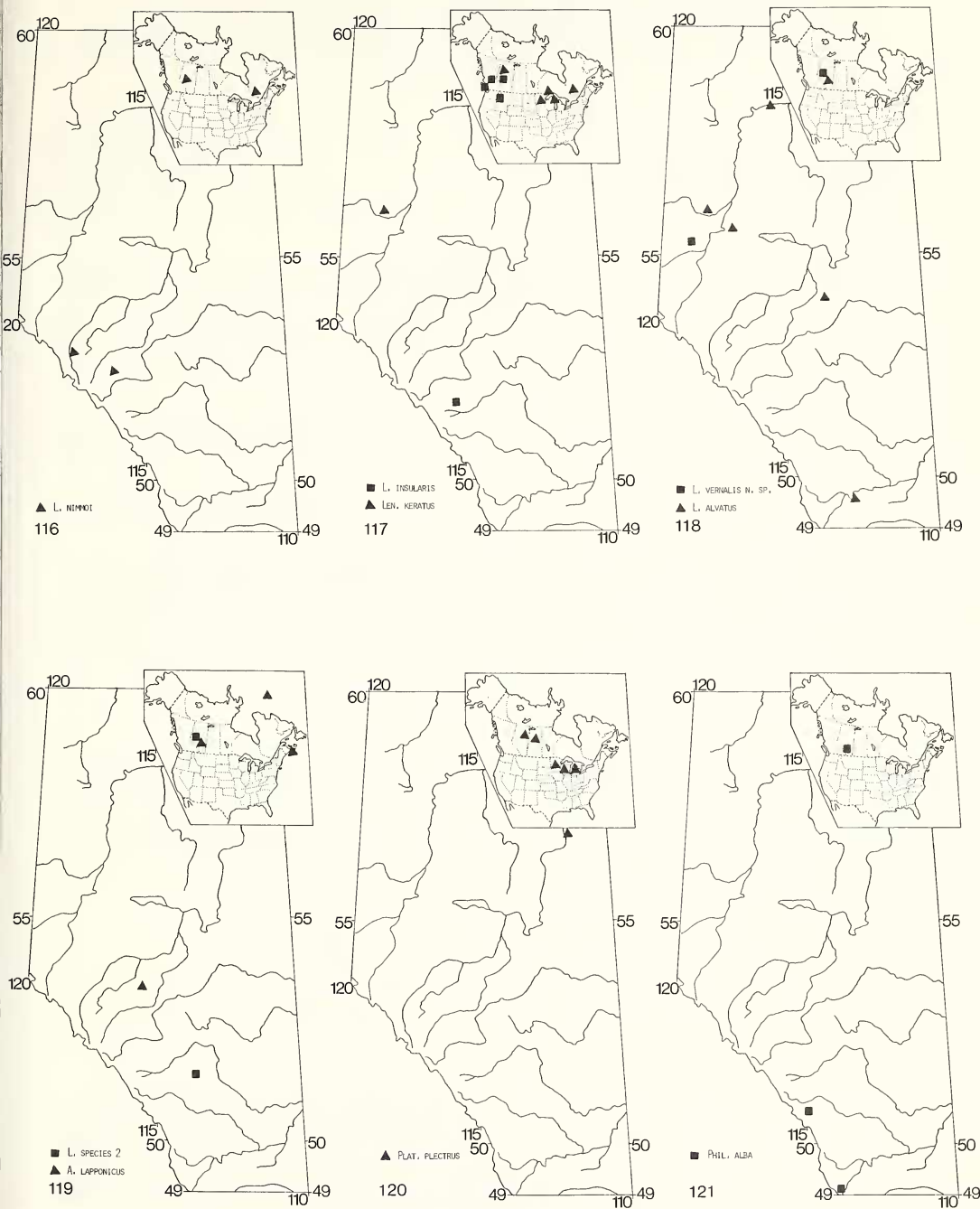


Fig. 116-121. Maps of distribution in Alberta & North America of: 116. *Limnephilus nimmoi* Roy and Harper. 117. *L. insularis* Schmid, *Lenarchus keratus* Ross. 118. *Limnephilus vernalis* Nimmo n. sp., *L. alvatus* Denning. 119. *L. species 2*, *Asynarchus lapponicus* (Zett.). 120. *Platycentropus plectrus* Ross. 121. *Philoscasca alba* Nimmo n. sp.

